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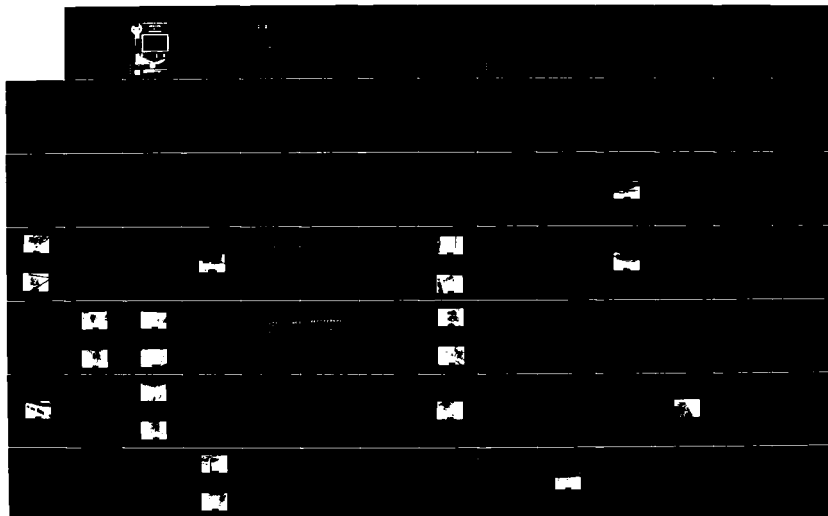
UNDERWATER FACILITIES INSPECTIONS AND ASSESSMENTS AT US
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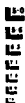
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**UNDERWATER FACILITIES
INSPECTIONS
AND
ASSESSMENTS
AT

U.S. NAVAL STATION

ROOSEVELT ROADS, P.R.**

FPO-1-82-(11)

FEBRUARY 1982

**PERFORMED FOR: OCEAN ENGINEERING AND CONSTRUCTION
PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C. 20374**

**BY: UNDERWATER CONSTRUCTION TEAM ONE NAB
NAB LITTLE CREEK, NORFOLK, VIRGINIA 23521**

**CONSULTANT: CHILDS ENGINEERING CORPORATION
MEDFIELD, MASSACHUSETTS 02052**

UNDER: CONTRACT NO. N00600-82-D-0002

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The objective of the underwater facility assessments conducted at the U.S.
Naval Station in Roosevelt Roads, Puerto Rico is to provide a generalized
structural condition report of the underwater portion of selected facilities
within the activity. These facilities are the Fuel Pier (266), Supply (Con't)

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Pier (267), Berthing Pier (799), Ammunition Pier (277), Berthing Wharf - Sections A to D (890), Berthing Wharf (280), LST Ramp (843), Approach Pier (273), Repair Pier (281) and the Small Craft Berth (844) in the Naval Station proper. On Vieques island, the designated facilities are the Ammunition Pier (2018), LST Ramp (2012) and the Small Craft Berth. Each facility was inspected by a team of divers from Underwater Construction Team One under the direction of topside engineers. Critical elements were photo-documented.

In general, the facilities exhibit conditions which are consistent with their age. No repair work is recommended for these seven facilities: Fuel Pier (266), the Ammunition Piers (277 and 2018), the Berthing Wharves (890 and 280), Repair Pier (281) and Small Craft Berth (844). However, inspection of elements beyond the scope of this report (i.e., pier superstructure and bulkhead tieback system) are recommended for the Ammunition Pier (277), Berthing Wharf (890), Repair Pier (281) and Small Craft Berth (844) to determine the present capacity of the total structure.

Repair work is recommended for the remaining facilities. The most extensive work is required at Approach Pier (273), which should be removed if it is no longer necessary, and at the Small Craft Berth on Vieques Island, which should be replaced with an entirely new facility. The concrete slabs in both of the LST Ramps should be repaired along their submerged edges, although more extensive patching as well as pressure grouting are necessary at the Naval Station's LST Ramp (843). The Supply Pier (267) and Berthing Pier (799) each have a damaged pile which must be repaired or replaced as soon as possible, both neither pier's capacity needs to be downgraded. Also, the steel sheet pile bulkhead at the base of the Supply Pier should be protected with a concrete encasement to prevent further deterioration.

FOREWORD

The scope of the inspection at the U.S. Naval Station in Roosevelt Roads, Puerto Rico and the detail to which it was performed and reported was tailored specifically to the conditions at this activity. This underwater inspection report and the procedures associated with its formulation are based on current inspection standards. These standards have evolved from previous criteria, developed in the preliminary stages of the Specialized Inspection Program. They provide the foundation on which current inspection standards are based. Through these standards, inspections performed by different persons on many facilities and under a wide range of conditions can be effectively compared. Work is underway to continuously upgrade these standards to meet or exceed current state-of-the-art practices as they are experienced in successive inspections such as this one at the Naval Station, Roosevelt Roads.

The Naval Station inspection represents the first time the Specialized Inspection Program had combined the efforts of a Navy Underwater Construction Team (UCT-1) with an Architect-Engineer (A&E) contractor to perform an underwater inspection and assessment. The experiences gained in this type of joint effort are expected to demonstrate its feasibility, providing optimum applications of both UCT and A&E specialized capabilities in future inspections.

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EXECUTIVE SUMMARY

The objective of the underwater facility assessments conducted at the U.S. Naval Station in Roosevelt Roads, Puerto Rico is to provide a generalized structural condition report of the underwater portion of selected facilities within the activity. These facilities are the Fuel Pier (266), Supply Pier (267), Berthing Pier (799), Ammunition Pier (277), Berthing Wharf - Sections A to D (890), Berthing Wharf (280), LST Ramp (843), Approach Pier (273), Repair Pier (281) and the Small Craft Berth (844) in the Naval Station proper. On Vieques Island, the designated facilities are the Ammunition Pier (2018), LST Ramp (2012) and the Small Craft Berth. Each facility was inspected by a team of divers from Underwater Construction Team One under the direction of topside engineers. Critical elements were photo-documented.

In general, the facilities exhibit conditions which are consistent with their age. No repair work is recommended for these seven facilities: Fuel Pier (266), the Ammunition Piers (277 and 2018), the Berthing Wharves (890 and 280), Repair Pier (281) and Small Craft Berth (844). However, inspection of elements beyond the scope of this report (i.e., pier superstructure and bulkhead tieback system) are recommended for the Ammunition Pier (277), Berthing Wharf (890), Repair Pier (281) and Small Craft Berth (844) to determine the present capacity of the total structure (refer to the Recommendations for each facility in Section 4 of this report).

Repair work is recommended for the remaining facilities. The most extensive work is required at the Approach Pier (273), which should be removed if it is no longer necessary, and at the Small Craft Berth on Vieques Island, which should be replaced with an entirely new facility. The concrete slabs in both of the LST Ramps should be repaired along their submerged edges, although more extensive patching as well as pressure grouting are necessary at the Naval Station's LST Ramp (843). The Supply Pier (267) and Berthing Pier (799) each

have a damaged pile which must be repaired or replaced as soon as possible, but neither pier's capacity needs to be downgraded. Also, the steel sheet pile bulkhead at the base of the Supply Pier should be protected with a concrete encasement to prevent further deterioration.

Refer to the following Executive Summary Table for an overview of each facility's construction and recommendations.

U.S. NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

EXECUTIVE SUMMARY TABLE

<u>Facility</u>	<u>Year Built or Modified</u>	<u>No. of Vertical Bearing Piles</u>	<u>No. of Batter Piles</u>	<u>Facility Size</u>	<u>Structure</u>
Fuel Pier (266)	1943; Repaired 1963 and 1978	132	40	450' long x 34' wide	Concrete-jacketed steel H-or WF- piles of varying sizes
Supply Pier (267)	1954	120	56	397' long x 38'wide	16" and 18" square precast, rein- forced concrete piles; four steel H-piles (repair piles); steel sheet pile bulkhead (PZ- 32 Sections)
Berthing Pier (799)	1966	1198	200	1209' long x 120' wide	18" square precast, prestressed con- crete piles and concrete-jacketed steel H-piles (HP 14x73)
Ammunition Pier (277)	1943	122	64	183' long x 32' wide	12" diameter steel pipe piles
Berthing Wharf- Sections A,B,C&D (890)	1965	—	—	3,738' long x 12' wide	Concrete-capped Steel Z Sheet piles of varying sizes
Berthing Wharf (280)	1957	22	4	131.5' long x 30' wide	Concrete-jacketed steel H-piles (mainly HP 12x74)
LST Ramp (843)	1963	—	—	62' long x 80' wide	Cast-in-place, reinforced con- crete slab and steel sheet piles (Z-27 Sections)
Approach Pier (273)	1944	54 Support Piles	—	1018' long x 15' wide	Steel sheet pile cylinders (M-112 Sections); 20" square precast, reinforced concrete piles and steel H- piles (HP 14x89)

U.S. NAVAL STATIONROOSEVELT ROADS, PUERTO RICOEXECUTIVE SUMMARY TABLE

<u>f</u> <u>r</u>	<u>Facility</u> <u>Size</u>	<u>Structure</u>	<u>Recommendations</u>	<u>Est. Cost</u> <u>of Recommen-</u> <u>dations</u>
	450' long x 34' wide	Concrete-jacketed steel H-or WF- piles of varying sizes	No repairs necessary	N/A
	397' long x 38'wide	16" and 18" square precast, rein- forced concrete piles; four steel H-piles (repair piles); steel sheet pile bulkhead (PZ- 32 Sections)	1) Repair damaged pile with epoxy grout 2) Protect steel bulk- head with concrete encasement	\$ 1,000 \$ 51,000
	1209' long x 120' wide	18" square precast, prestressed con- crete piles and concrete-jacketed steel H-piles (HP 14x73)	1) Replace damaged pile with two concrete- jacketed steel H- piles	\$ 16,000
	183' long x 32' wide	12" diameter steel pipe piles	No repairs necessary (see Section 4.4.4)	N/A
	3,738' long x 12' wide	Concrete-capped Steel Z Sheet piles of varying sizes	No repairs necessary (see Section 4.5.4)	N/A
	131.5' long x 30' wide	Concrete-jacketed steel H-piles (mainly HP 12x74)	No repairs necessary	N/A
	62' long x 80' wide	Cast-in-place, reinforced con- crete slab and steel sheet piles (Z-27 Sections)	1) Repair damaged mid- section and submerged edge of concrete slab; pressure grout under slab to fill voids	\$ 16,000
	1018' long x 15' wide	Steel sheet pile cylinders (M-112 Sections); 20" square precast, reinforced concrete piles and steel H- piles (HP 14x89)	1) Remove pier if no longer necessary or 1) Repair pier by patching piles caps with epoxy mortar, protecting steel sheet pile cylinders with new sheet piling, and repairing split in cylinder with a steel plate	\$200,000 \$1,200,000

U.S. NAVAL STATION
ROOSEVELT ROADS, PUERTO RICO

EXECUTIVE SUMMARY TABLE

(cont'd)

<u>Facility</u>	<u>Year Built or Modified</u>	<u>No. of Vertical Bearing Piles</u>	<u>No. of Batter Piles</u>	<u>Facility Size</u>	<u>Structure</u>	<u>Ref</u>
Repair Pier (281)	1943	21	—	160'long x 75'wide	42"square re- inforced con- crete columns	No 2 (se
Small Craft Berth - North & South Quay- walls (844)	1943	34	—	412'long 50'wide	42"square re- inforced con- crete columns	No (se
Ammunition Pier- Vieques Island (2018)	1966	172	94	651'long x 40'wide	18"square pre- cast, prestressed concrete piles	No
LST Ramp - Vieques Island (2012)	1964; Extended in 1969	—	—	95'long 80'wide	Cast-in-place, reinforced con- crete slabs	1) F 4 e s r
Small Craft Berth - Vieques Island	1940	—	—	139'long x 26'wide	Steel sheet piles (MP Sections)	1) F f

U.S. NAVAL STATION

SEVELT ROADS, PUERTO RICO

EXECUTIVE SUMMARY TABLE

(cont'd)

<u>Facility Size</u>	<u>Structure</u>	<u>Recommendations</u>	<u>Est. Cost of Recommen- dations</u>
160'long x 75'wide	42"square re- inforced con- crete columns	No repairs necessary (see Section 4.9.4)	N/A
412'long 50'wide	42"square re- inforced con- crete columns	No repairs necessary (see Section 4.10.4)	N/A
651'long x 40'wide	18"square pre- cast, prestressed concrete piles	No repairs necessary	N/A
95'long 80'wide	Cast-in-place, reinforced con- crete slabs	1)Repair submerged edge of concrete slab with epoxy mortar	\$ 11,000
139'long x 26'wide	Steel sheet piles (MP Sections)	1)Replace with new facility	\$360,000

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SECTION 1

INTRODUCTION

This report is a product of the Underwater Facilities Inspection Program conducted by the Ocean Engineering and Construction Project Office (FPO-1), Chesapeake Division (CHESDIV), Naval Facilities Engineering Command (NAVFAC). The Underwater Facilities Inspection Program falls under the NAVFAC Specialized Inspection Program. Managed and executed by CHESDIV, the program is intended to be responsive to the needs of the Fleet as far as inspection of waterfront facilities.

Mandated under Government Contract No. N00600-82-D-0002, VSE Corporation Purchase Order No. 47977, this project entails technical and engineering services for the inspection, damage and deterioration assessment, repair analysis and cost estimates for repairs for the submerged portions of selected Naval Waterfront Facilities. The inspection is usually conducted or managed by on-site structural diver engineers.

For this inspection, responsibility for the various aspects of the project was shared among several organizational groups. The U.S. Naval Underwater Construction Team One (UCT-1) performed the underwater inspection and data collection. A representative from CHESDIV provided on-site technical and engineering support to UCT-1 for a portion of the inspection period as well as providing general technical direction for the whole project and acting as liason among the Naval Station, UCT-1, CHESDIV and the subconsultant. Representatives from Childs Engineering Corporation, as subconsultants to VSE Corporation, also provided on-site technical and engineering support to UCT-1, oversaw the acquisition of field notes and measurements, and performed limited underwater inspection services in order to become familiar with general conditions and secure photographic documentation. Using the data and documentation thus collected, personnel at Childs Engineering Corporation

prepared this Underwater Facilities Inspection and Assessment Report.

The efforts expended and costs required to perform these underwater facilities inspections vary greatly with the size, age, kind and construction type of the facilities involved. Other factors peculiar to a particular facility or activity also have an important effect on inspection time and costs. These factors include:

- *Type and quantity of biofouling to be cleaned for different levels of scrutiny, both visual and with instruments;
- *Tidal range - area exposed at low tide for boat inspection;
- *Time and type of last inspection and repair work;
- *Local environmental factors - salinity, pollution level, temperature, etc., affecting rates of corrosion and marine life;
- *Function of the facility and the level of activity associated with that function.

1.1 TASK DESCRIPTION

The scope of work for this portion of the program required the inspection of the underwater portion of designated waterfront facilities located at the U.S. Naval Station in Roosevelt Road, Puerto Rico. The quality of inspection had to be sufficient to provide an adequate general structural assessment of the facilities and to identify areas of sufficient damage and/or deterioration to warrant immediate repair or a future, more detailed investigation.

1.2 REPORT CONTENT

The report contains a description of inspection procedures, the results of the inspection and analysis of the findings, accompanied by pertinent drawings and photographs. Specifically, the inspection results include a description of the location, construction and function of each facility examined within the Naval Station,

its observed condition and a structural assessment of that condition. Recommendations for each facility, including cost estimates for any repair work, are also included. Structural assessment calculations and cost estimate breakdowns can be found in the Appendix. Also, as supplementary information, a brief description of the Naval Station is provided to define its location, operational functions, history, existing facilities, climate, topography and hydrology.

SECTION 2

ACTIVITY DESCRIPTION

This section provides a general description of the U.S. Naval Station at Roosevelt Roads, Puerto Rico and nearby Vieques Island. The description includes brief discussions of the Naval Station's location, operational functions, history, existing facilities, climate, topography and hydrology. This information provides a more overall view of the activity and a perspective to accurately assess the structural conditions of the facilities inspected.

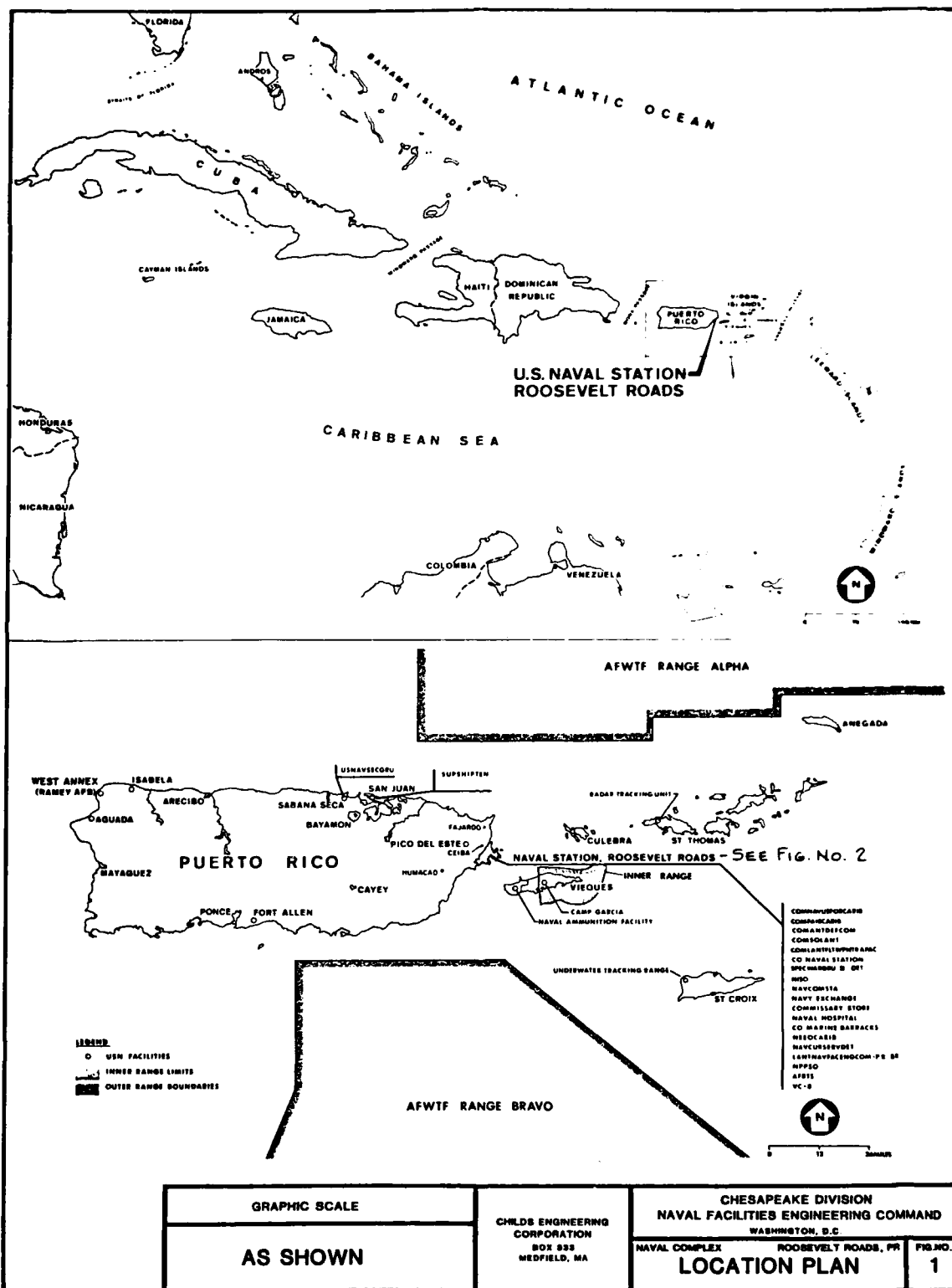
2.1 LOCATION OF ACTIVITY

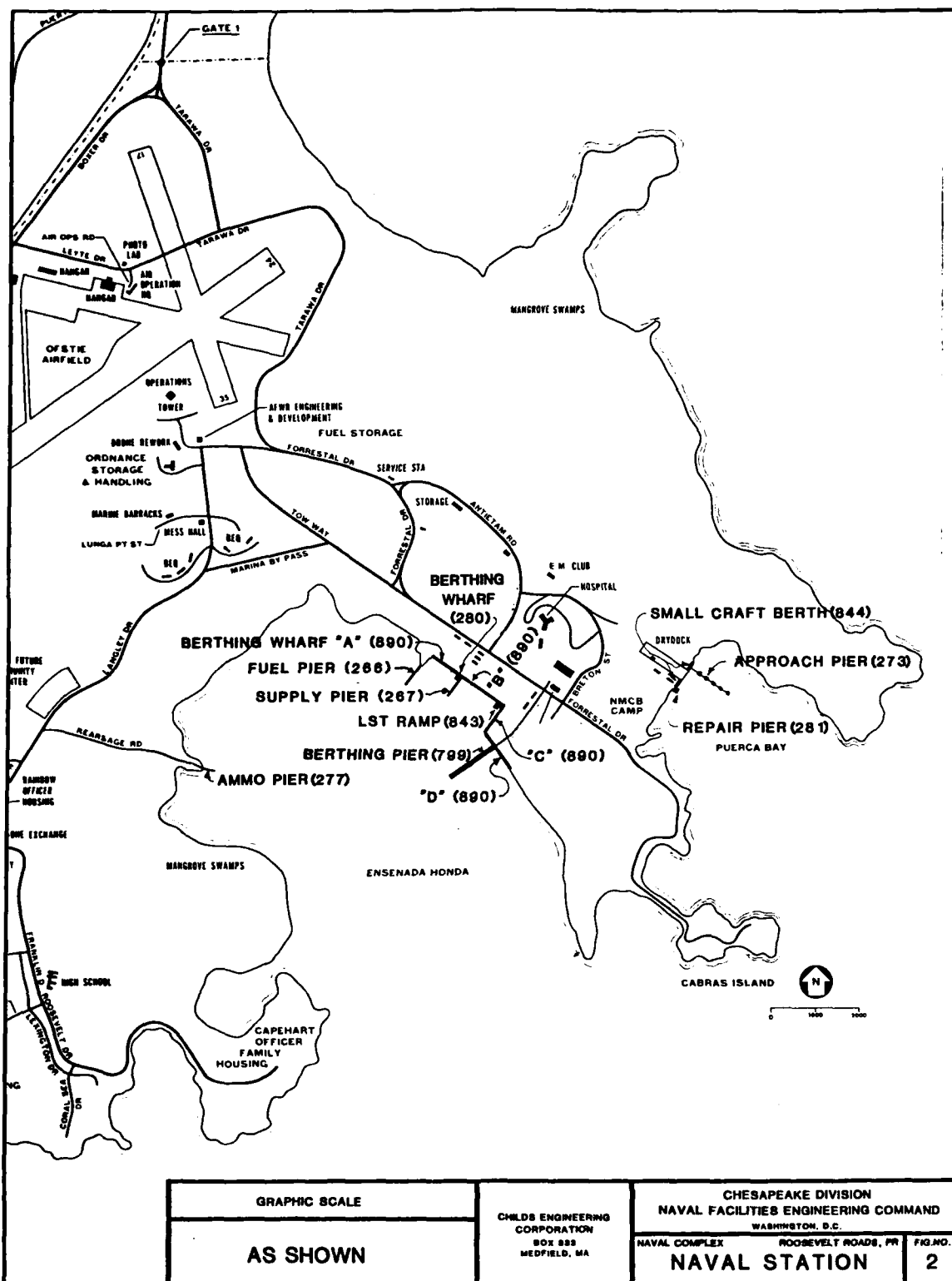
The Naval Station is located on the southeastern coast of Puerto Rico in the Municipality of Ceiba, at 18° 14' north latitude and 65° 37' west longitude. It is approximately 40 miles southeast of downtown San Juan. The Naval Station and nearby Vieques Island are part of a Caribbean Naval Complex which also includes installations in other parts of Puerto Rico and on the islands of Culebra, St. Thomas and St. Croix. The facilities inspected for this report were located in the Naval Station and on Vieques Island (see Figures 1-3).

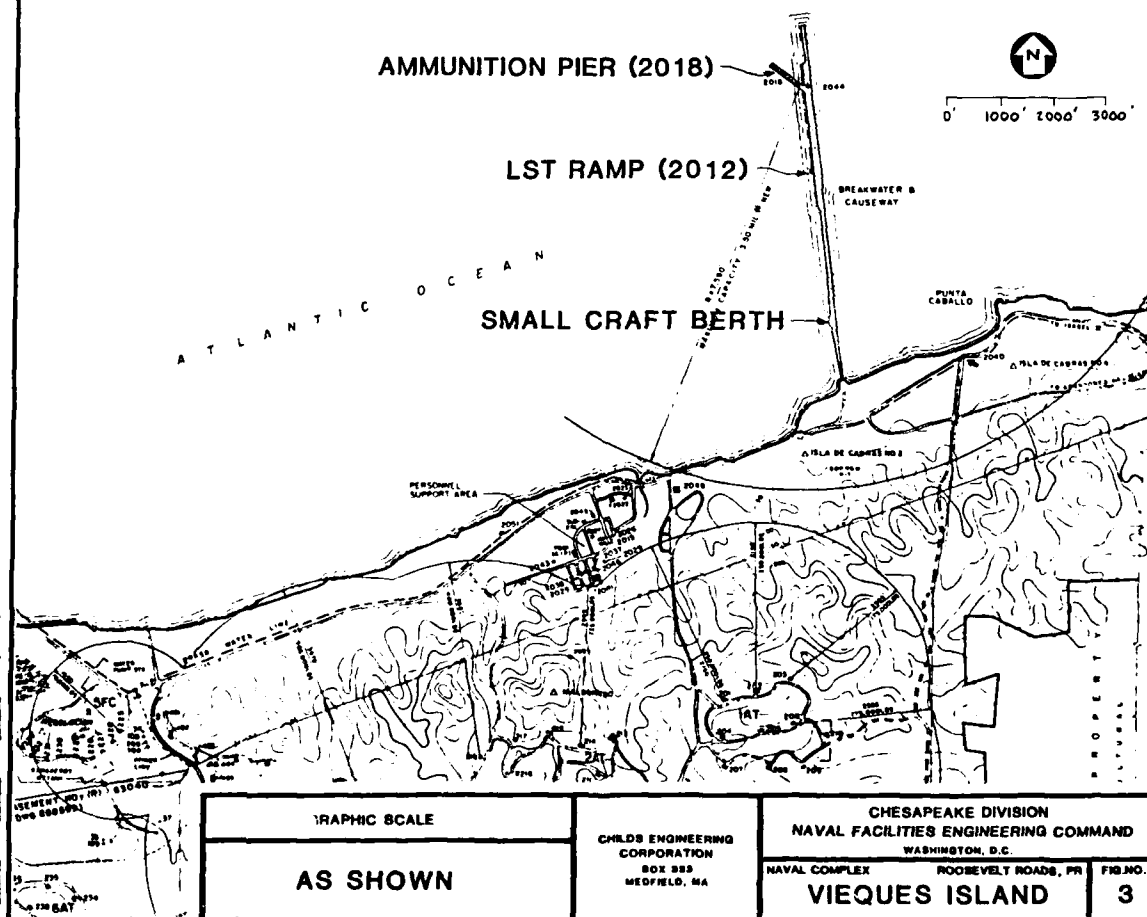
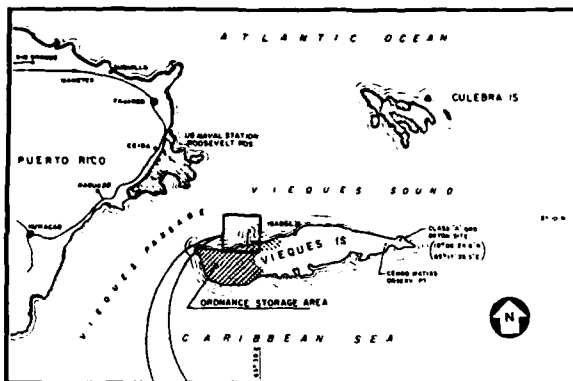
2.2 OPERATIONAL FUNCTIONS

"The underlying theme for all facility planning at Naval Station, Roosevelt Roads, is the provision of physical environment (real estate, buildings, utilities, etc.) in which all assigned activities can effectively accomplish their assigned missions and tasks."1 The following "are the major units on Naval Station, Roosevelt Roads, whose mission requirements have a significant impact on facility planning"2:

Commander, U.S. Naval Forces Caribbean (COMNAVFORCARIB)
Commander, Antilles Defense Command (COMANTDEFCON)
Commander, Fleet Air Caribbean (COMFAIRCARIB)
Commander, South Atlantic Force (USCOMSOLANT)
Commanding Officer, U.S. Naval Station, Roosevelt Roads, Puerto Rico,, (CO NAVSTA ROOS RDS)
Commander, Atlantic Fleet Weapons Training Facility (LANTFLTWPNTAFAC)
Commander, Fleet Air Detachment (General)
Fleet Composite Squadron EIGHT (VC-8)







U.S. Naval Communications Station, Puerto Rico (NAVCOMMSTA)
 Naval Mobile Construction Battalion
 Naval Weather Service Environmental Detachment (NWSER)
 Marine Barracks
 Fleet Audio-Visual Center, Caribbean
 Navy Publication and Printing Service Office, Southeastern
 Division (NPPSO SEDIV)
 Navy Investigative Service Resident Agency (NAVINSERV)
 Naval Electronic Engineering Office Caribbean (NEEO CARIB)
 U.S. Naval Hospital
 U.S. Naval Regional Dental Center
 Special Warfare Training Group Two - Carib Det.

2.3 HISTORY OF ACTIVITY

"The U.S. Naval Operating Base, Roosevelt Roads, was commissioned in 1943. The essential operations and industrial facilities were completed in three years. On 1 September 1944, the base was redesignated the U.S. Naval Station, Roosevelt Roads, and in November 1944, it was placed in caretaker status. In the spring of 1947, it was again reestablished as a Naval Operating Base. During these changes of status, it was utilized primarily as a training site for portions of the Atlantic Fleet and functioned as an important refueling station."³

"In 1955, the Atlantic Fleet Guided-Missile Training Center was established and Roosevelt Roads, redesignated a Naval Station. The mission was to support guided missile and other training operations of the Operating Forces."⁴

"In 1957, Fort Bundy (U.S. Army), located on the southern tip of the Naval Station, Roosevelt Roads was acquired. Fort Bundy was established in 1940 as headquarters for all coastal artillery emplacements. In 1947, the post was placed in a standby status, and in 1950, became inactive again."⁵

"Roosevelt Roads has provided support for various special and joint exercises that are held annually in the Caribbean waters (i.e. Operation Springboard, CARIBEX, etc.) for the Atlantic Fleet as well as foreign navies.

Roosevelt Roads also provides support to tenant activities. The history of Atlantic Fleet Weapons Range Training Facility (AFWTF) began with the Guided-Missile Operations Control Unit (GMOCU). In July 1963, AFWTF was commissioned as a separate activity. In July 1967, AFWTF activated its computerized Central Command and Control System (CCCS). The new CCCS is oriented around the Naval Tactical Data System (NTDS) allowing a rapid exchange of data between ships and aircraft exercising many miles at sea. The inauguration of the CCCS marked another milestone in the evolution of the Roosevelt Roads Complex as one of the largest, most technologically advanced

training complexes in the world."⁶

"During the early 1970's, the closure of the Naval Station, San Juan brought four major Commands to Roosevelt Roads: Commander, Tenth Naval District, Commander, Caribbean Sea Frontier, Commander, Antilles Defense Command and Commander, Southern Atlantic."⁷

2.4 EXISTING FACILITIES

The major waterfront facilities in the Naval Station proper are those designated for inspection. In the Ensenada Honda area, these include four stationary piers (a fuel pier, a supply pier, a berthing pier and an ammunition pier), four sections of berthing wharf running from the fuel pier to the berthing pier, a smaller berthing wharf at the base of the supply pier and an LST landing ramp. In nearby Puerca Bay, the existing facilities are centered around Dry Dock No. 1 which is now being used as a wet slip. These facilities are an approach pier on one side of the dry dock's mouth, a repair pier on the other side, and small craft berthing wharves on both sides of the mouth (see Figure 2).

On Vieques Island, all the designated waterfront facilities are located on the western edge of a breakwater and causeway built in the northwest sector of the island. These are an ammunition pier, an LST ramp and a small craft berth (see Figure 3).

2.5 CLIMATE

"The climate of the study area is characterized as warm and humid with frequent showers throughout the year. A major factor affecting the weather is the trade winds associated with the Bermuda High, the center of which is in the vicinity of 30 degrees north, 30 degrees west. The trade winds persist throughout the year, producing a wind pattern varying from northeast to southeast according to season. The mean annual wind velocity is 5-1/2 knots with a minimum in November and a maximum in August."⁸

"Uniform temperatures prevail, with small diurnal ranges as a result of the insular exposure and relatively small land areas. The warmest months are August and September while the coolest are January and February. Normally, the temperature extremes are

92 degrees F and 62 degrees F. Rain usually occurs at least nine days in every month, with an average of 60 inches per year. A dry winter season occurs from December through April. About 22 thunderstorm days occur per year with maximum frequencies of three days per month from May through October."⁹

"The hurricane season is from mid-June through mid-September, and maximum winds exceed 95 knots during severe hurricanes. An average of two tropical storms per year occur in the study area, one of which usually reaches hurricane intensity."¹⁰

2.6 TOPOGRAPHY

The topography at the Naval Station, Roosevelt Roads, is fairly hilly. Elevations range from sea level along the coast to approximately 295 feet above sea level inland. Just north of the Station's boundary, the hills rise sharply to 800 - 1050 feet above sea level. A large portion of the Station's land area is not usable due to the high costs of developing the hillside areas and the coastal mangrove swamps.

"The topography on Vieques provides both challenging target areas on the eastern end of the Island and an ideal setting for ordnance storage magazines on the western end. The hillside location of many magazine groups provides additional protection for the magazines from both an explosive standpoint and for concealment. . . . The hilly terrain, however has created severe erosion problems on most of the roads within the ammo storage area."¹¹

2.7 HYDROLOGY

"To date no specific study has been prepared solely for the determination of the flood plain, however, all future flood sensitive construction should be located in areas historically free from flooding and above elevation 15 feet above mean sea level (AMSL) wherever possible. Many prime development sites are located below this elevation but are more subject to seawater flooding resulting from storms, wind and abnormally high tides than surface water flooding. The tidal ranges in the Roosevelt Roads area are rather small, with a maximum spring range of less than three feet."¹²

Tidal ranges for the Roosevelt Roads area are as follows:

	Feet
MEAN LOW WATER	100.0 (Naval Station Datum)
MEAN TIDE LEVEL	100.3
MEAN TIDE RANGE	0.7
SPRING TIDE RANGE	0.8

(Taken from Tide Tables 1982, U.S. Dept. of Commerce, NOAA)

SECTION 3

INSPECTION PROCEDURE

Between January 25 and February 5, 1982, the U.S. Navy's UCT-1 performed an on-site underwater inspection of selected facilities within the U.S. Naval Station, Roosevelt Roads, Puerto Rico. From January 25-29, the UCT-1 worked under the direction of a CHESDIV engineer. From February 1-5, they worked under the direction of an engineer from Childs Engineering Corporation. From February 6-8, two engineers from Childs Engineering Corporation performed some limited on-site underwater inspection work. The level of inspection to be performed, the type of structure being inspected, actual on-site conditions and past experience, combined with a thorough knowledge of engineering theory, dictated the inspection procedures that were followed.

3.1 LEVEL OF INSPECTION

The inspection techniques used had to be sufficient to yield information necessary to make a general condition assessment of the supporting structure of each facility, identify any areas that were mechanically damaged or in advanced states of deterioration, and formulate repair and maintenance recommendations and cost estimates. In general, this meant utilizing visual/tactile inspection techniques, accompanied by occasional external measurements employing such instruments as a scale, calipers or ultrasonic steel thickness gauge, where appropriate. Photographic documentation of typical as well as notable or unusual conditions was also obtained.

3.2 INSPECTION PROCEDURE

The scope of work for this portion of the Underwater Inspection Program required that thirteen facilities at the Naval Station and on Vieques Island be inspected from the splash zone to the mudline for general conditions and any gross structural damage or deterioration. The fender and utility systems were beyond the scope of this inspection.

Generally, two levels of inspection were utilized. In a "close" inspection, divers would inspect the piles, columns or bulkhead from the splash zone or pile cap to the mudline. Frequently, small patches were cleared of marine growth and/or corrosion in order to make an adequate structural assessment of the member. If the material were steel, ultrasonic thickness and/or caliper readings were taken in selected areas to provide a baseline for future inspections. If the material were reinforced concrete, inspection involved the noting of any severe cracking, spalling or rusting. The concrete was hit with a hammer to gauge its soundness and detect any softness that might be present. In the more cursory "swim-by" inspection, the submerged structural members were merely swum by at or below mean low water since much of the damage or deterioration was seen in this area. The levels of inspection utilized are indicated on the facility drawings included in the following section of this report. Those piles or columns not closely inspected or swum by were not inspected at all.

All steel sheet pile bulkheads (the Berthing Wharf (890), the LST Ramp (843), the base of the Supply Pier and the Small Craft Berth on Vieques Island) were closely inspected. For this type of structure, two divers would swim in tandem, one near the surface and the other 5'-10' below him. In this manner, due to the clarity and shallow depth of the water, the whole bulkhead could be inspected.

It should be noted that during our investigation no destructive testing was performed. The conditions noted reflect direct observation or measurement of structural components which were accessible. Information which may infer knowledge of conditions of hidden components are based on government-furnished documents, our knowledge of structures in similar environments and/or generally accepted engineering theories. General comments concerning elements beyond the scope of this project (i.e., areas above the splash zone) were included in order to provide a more overall picture of the condition of each facility. These comments are cursory in nature and not intended to be conclusive.

3.3 INSPECTION EQUIPMENT

Equipment used for the inspection included a Krautkramer D-meter ultrasonic steel thickness gauge with DMR probe and 75 feet of cable, a 35mm camera, a Nikonos III underwater camera with Nikon 28mm lens and Oceanic 2001 strobe, dive lights, 50-foot cloth tape, 6-foot folding rule, calipers, chipping hammers and dive knives.

Choice of equipment was made as a result of past experience. Most of the equipment is straightforward, easy to handle, carry and use, and has proven reliable under hard use.

Ultrasonic steel thickness gauging is preferred over other techniques (such as drilling test holes) since it is non-destructive, easy to handle, fast and reasonably accurate.

SECTION 4

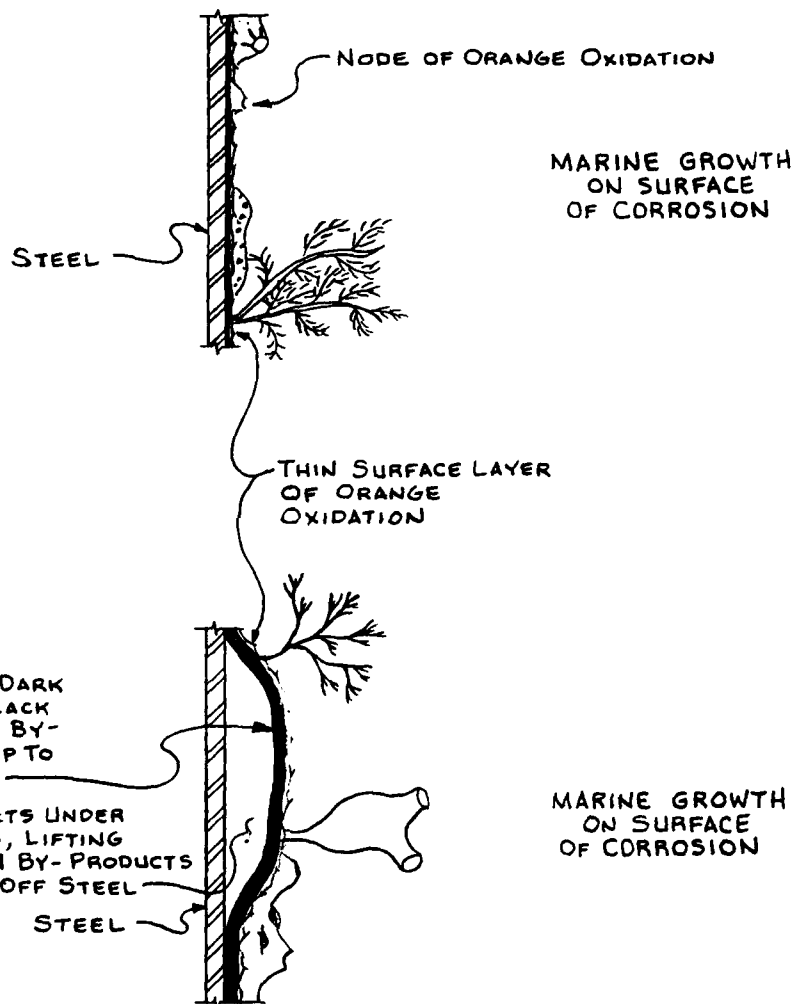
FACILITIES INSPECTED

Within this section of the report, each facility inspected at the Naval Station and on Vieques Island is referenced separately. U.S. Navy facility numbers follow the names of all the facilities for which they were provided to avoid confusion in identifying each structure. The discussion of each facility is presented in four parts: 1) a description of the location, construction and function of the structure, which is derived both from the on-site inspection and from the referenced government-furnished drawings; 2) an enumeration of general and specific conditions observed during the on-site inspection; 3) a qualitative assessment of the structural condition of the facility based on the inspection data; and 4) recommendations for actions to be taken to insure long-term, cost-effective maintenance and utilization of the facility. Detailed breakdowns of cost estimates are included in the Appendix.

Marine growth profiles were noted for each facility. These profiles were similar for all the facilities inspected. In general, a 2"-3" thick mat of sponges, tunicates, hydroids and a variety of other sessile animals and plants covered both steel and concrete structures from mean low water to mudline. Growth thinned down quickly above mean low water to essentially nothing in the splash zone. Typical marine growth can be seen in all the underwater photos in this section.

On the older facilities with steel piles, deposits of black corrosion by-product with gas pockets trapped beneath were not uncommon. This corrosion buildup was not heavy, usually less than 1/4" thick. Patches of orange oxidation were seen on all steel structures, particularly at any interface between concrete and steel. Both types of corrosion are illustrated in Figure 4 .

The terms "cosmetic spalling" and "softness" are frequently



GRAPHIC SCALE	CHILDS ENGINEERING CORPORATION P.O. BOX 333 MEDFORD, MA	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.	FIG. NO.
N/A		NAVAL COMPLEX ROOSEVELT ROADS, PR	4
TYPICAL CORROSION BUILDUP			

used in this section. Cosmetic spalling is used to indicate surface spalling of concrete that does not affect the structural integrity of the structure. The term "softness" indicates that the concrete can easily be chipped away when struck by a chipping hammer. This is a sign of deterioration, the seriousness of which must be evaluated in each instance. Since softness is often associated with spalling and/or cracking of the concrete, it is usually considered in conjunction with these other conditions.

The term "superstructure" is also used in this section. It refers to that portion of the facility above the splash zone, including, for example, pile caps, beams and the underside of the decking. Only a cursory inspection was made of this area as it was beyond the scope of this project. A more detailed examination of this portion of each facility should be made by the Naval Station, particularly in instances where the cursory inspection revealed extensive deterioration.

4.1 FUEL PIER - PIER 1 (266)

4.1.1 Description

The Fuel Pier is the northernmost facility in the Ensenada Honda area of the Naval Station. It is located in the northeastern sector of the harbor, just west of Section A of the Berthing Wharf (890). It is presently used to receive and issue fuel and for general purpose berthing (see Photo #1).

The Fuel Pier was built in 1943, although extensive repairs were made in 1967 and 1978. In 1978, the old timber decking was replaced by a new reinforced concrete deck and damaged concrete jackets on the steel piles were replaced with new ones. The 450' long x 34' wide pier is supported by 33 bents with a total of 40 batter and 132 vertical bearing steel piles (see Figure 5). According to government-furnished information, a number of different structural shapes were used for pier piles, varying from W 10x54 to HP 14x89, inclusive. The piles are reportedly encased by 1'-8" square reinforced concrete jackets from the pile cap to elevation 98.5'. The concrete deck is designed for a live load of 200 PSF uniform loading or truck loading of AASHO H-15. The pier is designed for a side thrust of 2000 PLF.

References: Atlantic Division, Naval Facilities
Engineering Command
"Repairs to Fuel Pier No. 1"
NAVFAC Dwg. No. 4029470

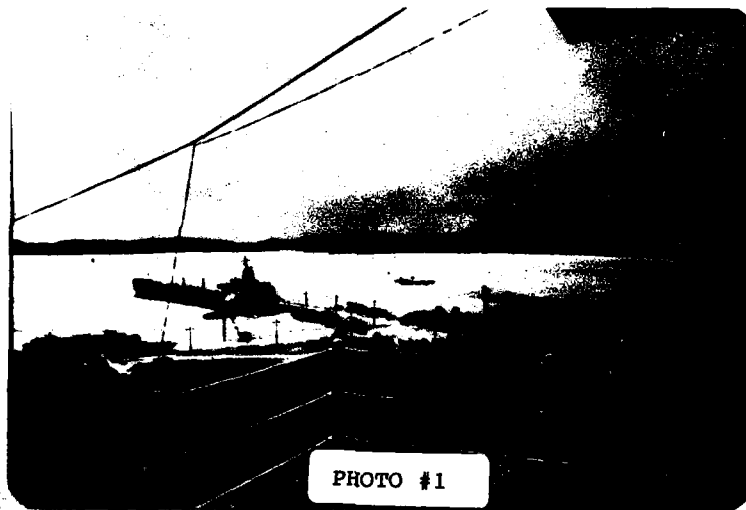
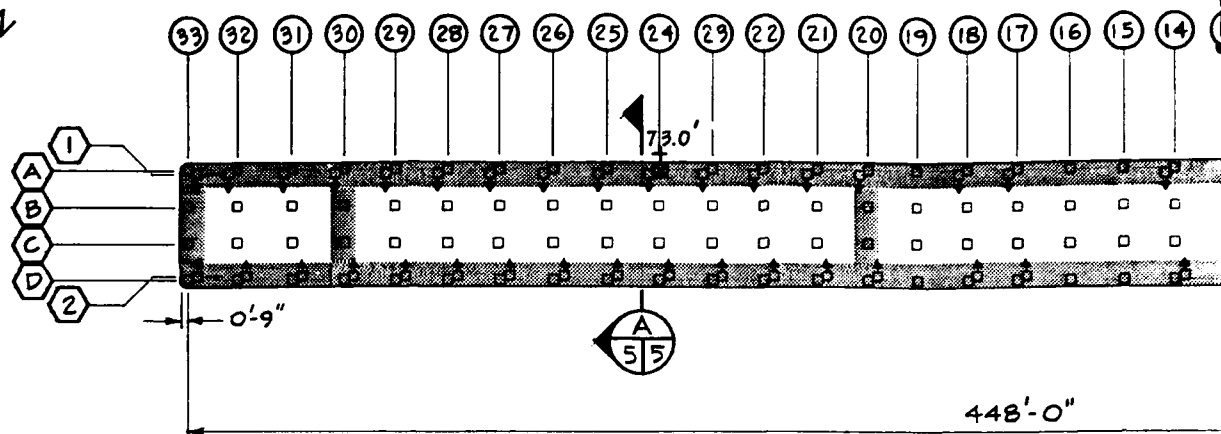
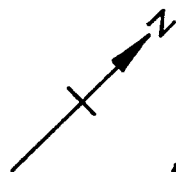


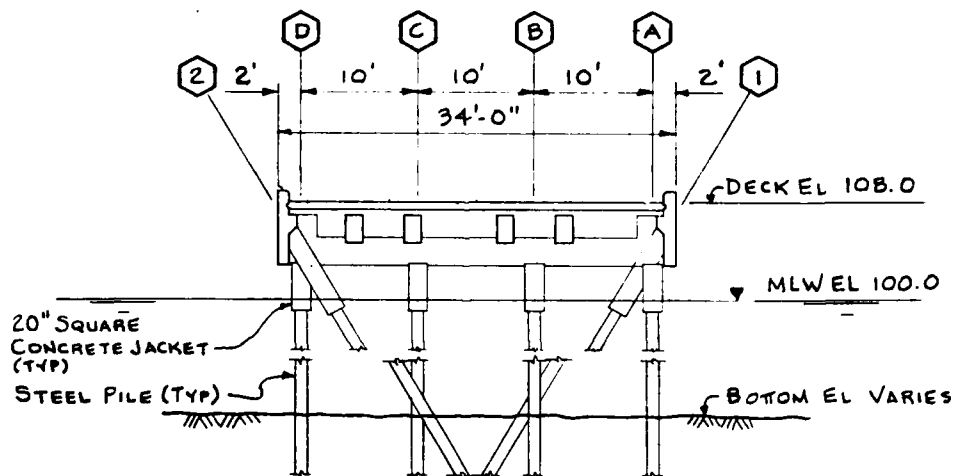
PHOTO #1: View of Fuel Pier (266)
from the Naval Station



PLAN

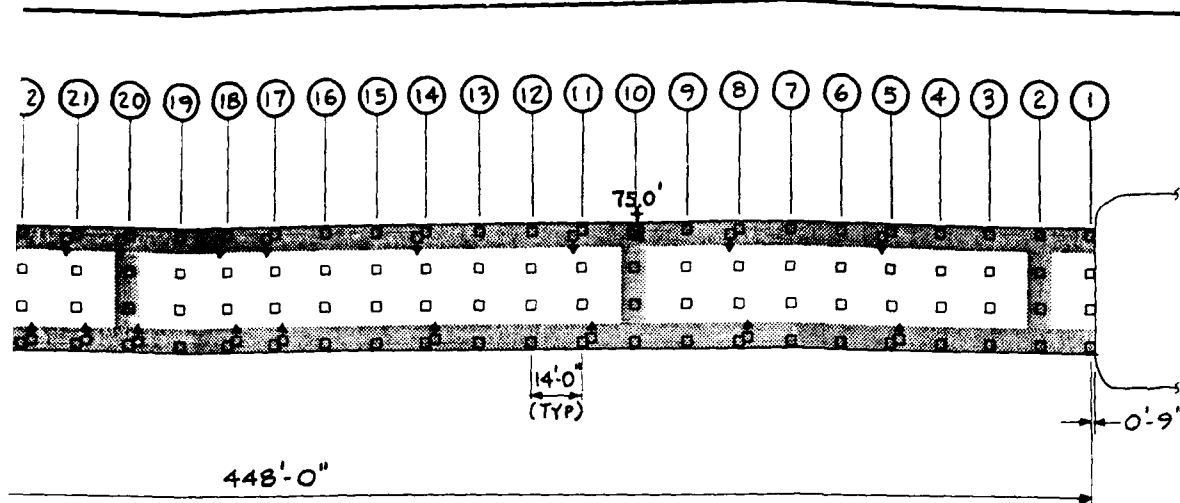
SCALE: 1" = 40'

0 10' 20' 30' 40'



SECTION NOT TO SCALE

NOTE
SECTION
DWG. No.



PLAN
 SCALE: 1" = 40'
 0 10' 20' 30' 40'

NOTE:
 BATTER PILES NOT PRESENT
 IN 13 BENTS, ACCORDING TO
 F.E.C. DWG. No. 1122406.

LEGEND

- - VERTICAL PILE
- - BATTER PILE
- Ⓐ - VERTICAL PILE DESIGNATION (FROM USN)
- ① - BATTER PILE DESIGNATION (FROM CHESDIV STANDARDS)
- ② - BENT No. (FROM USN)
- ⊗ - STEEL THICKNESS MEASUREMENTS TAKEN
- - CLOSELY INSPECTED PILES, REMAINING PILES
 NOT INSPECTED (SEE SECTION 3.2)
- + - SOUNDING (MLW)

NOTE:
 SECTION TAKEN FROM NAVFAC
 DWG. No. 4029470.

GRAPHIC SCALE	CHILDS ENGINEERING CORPORATION BOX 323 MEDFIELD, MA	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.	FIG. NO.
AS SHOWN		NAVAL COMPLEX ROOSEVELT ROADS, PR FUEL PIER (#266)	5

4.1.2 Observed Inspection Condition

The concrete jackets, which were apparently repaired or replaced in 1978, appeared to be in good condition. Reinforcing steel was exposed in some of the jackets, but this condition appeared to be the result of the installation rather than impact damage or concrete deterioration. Many of the jackets extended to elevations well below elevation 98.5', with some as deep as elevation 90.0'.

The concrete jackets in the tidal zone and the concrete superstructure appeared to be in good condition. Minor cracking and spalling was noted in these areas, but it was cosmetic and not structurally significant.

The exposed portions of the steel piles exhibited moderate to severe pitting (see Photo #2) and, in some cases, thinning of the flange edges. Both these conditions were the result of corrosion. Two piles were measured to determine the extent of corrosion. Average metal loss on the measured piles was between 15% and 22% (see Appendix for thickness readings).

Observation of the sizes of the piles indicated that there was an even greater size range than reported in the government-furnished information. The largest piles encountered were HP 14x102 sections. In some cases, beam shapes, whose flange width and depth are not equal, were used. Some piles were 14" deep with a flange width of 8" (see Photo #3).

Soundings indicated that the average water depth around the pier perimeter was about 28' at mean low water.

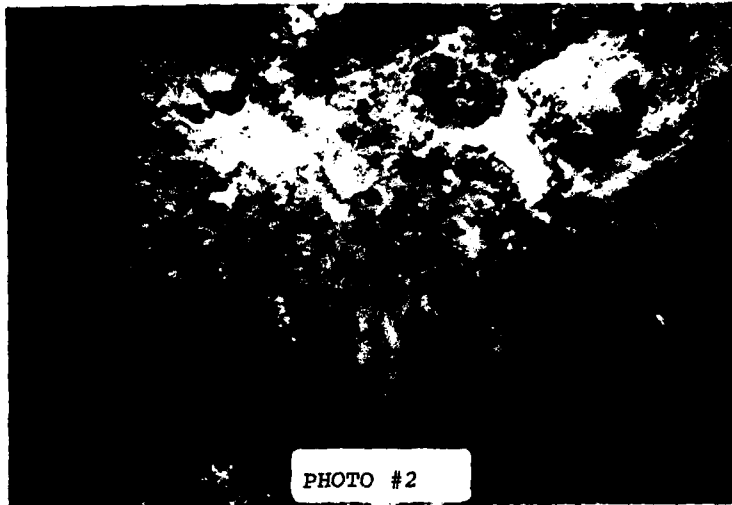
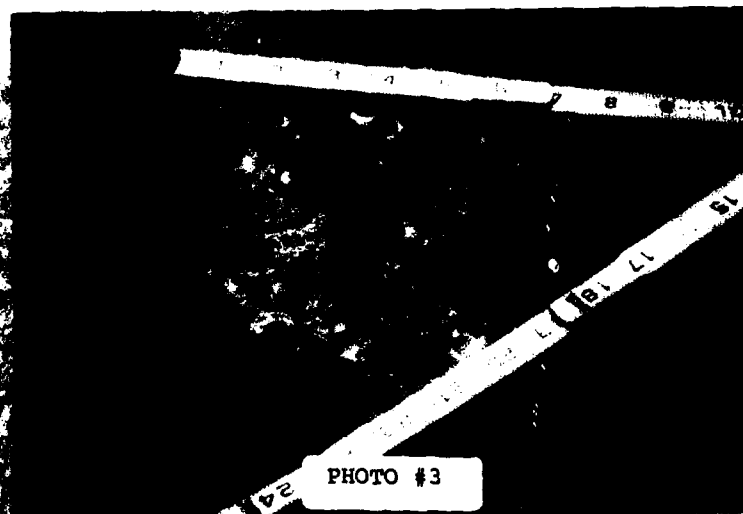


PHOTO #2: Flange of Steel H-pile in Fuel Pier (266) Just Below Concrete Jacket, Showing Typical Corrosion and Pitting of Steel (Bent 8, Pile A)

PHOTO #3: Example of Steel Pile in Fuel Pier (266) with Beam Shape (8" Wide x 14" Deep; Bent 11, Pile A)



4.1.3 Structural Condition Assessment

The Fuel Pier appears to be in good condition, and the pile foundation has sufficient capacity to handle the imposed loads. The observed deterioration is consistent with the age and type of construction of the pier.

An analysis of the remaining capacity of the two piles which were measured (an HP 14x102 and an HP 14x89) indicates that both piles have significantly more column strength than is required to handle the imposed loads. There has not been sufficient loss of section to conclude that piles of smaller size have deteriorated to a critical point at this time.

4.1.4 Recommendations

No repairs are needed at this time. The repairs accomplished in 1967 and 1978 have served to rehabilitate the Fuel Pier and extend its useful life.

The Fuel Pier should be reinspected in five years to document any deterioration. This report should be used as a baseline for the future inspections.

4.2 SUPPLY PIER - PIER 2 (267)

4.2.1 Description

The Supply Pier is situated in the Ensenada Honda area of the Naval Station, southeast of the Fuel Pier. It is sandwiched in between Section A of the Berthing Wharf (890) and the smaller Berthing Wharf (280) to the northwest and Section B of the Berthing Wharf (890) to the southeast. It presently functions as a general purpose berthing facility (see Photo #4).

The Supply Pier was built in 1954 and is 397' long x 38' wide. The reinforced concrete deck is supported by 29 bents with a total of 56 batter and 120 vertical bearing piles (see Figure 6). The piles are 16" and 18" square precast, reinforced concrete piles. There are also four steel H-piles, with concrete jackets from the pile cap to elevation 98.5', that were driven as the repair for two damaged concrete piles. At the base of the pier and extending approximately 16' to either side of the pier is a steel sheet pile bulkhead comprised of PZ32 sheet piles. The design live load for the deck is 400 PSF uniform loading or H-20 truck loading.

References: Tenth Naval District, Bureau of
Yards and Docks
"Pier No. 2"
Y & D Dwg. No. 603341

U.S. Naval Station, Roosevelt Roads
"Repairs to Fender System - Pier No. 2"
P.W. Dwg. No. 4656

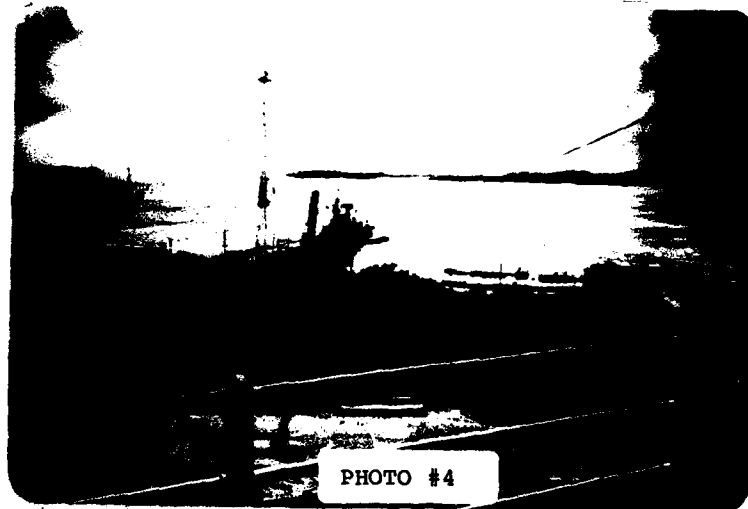
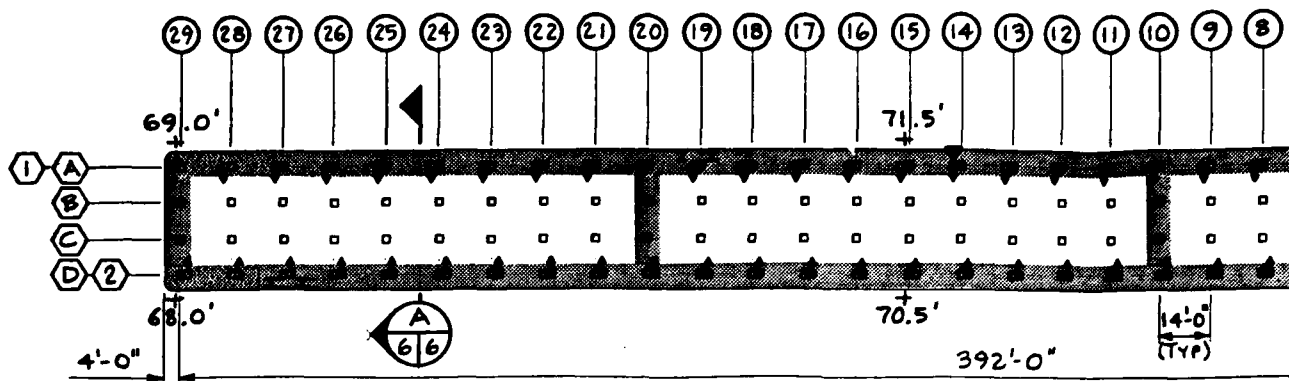


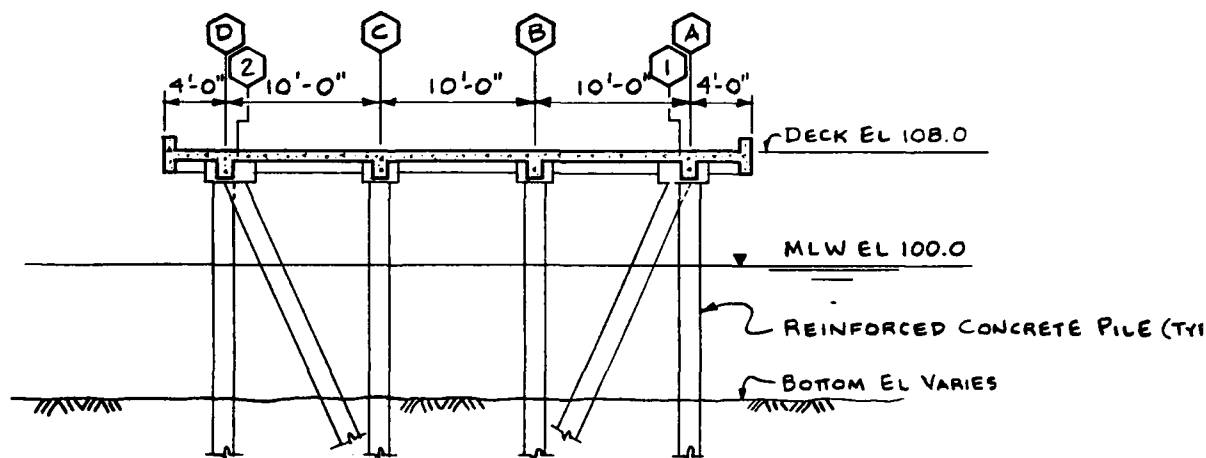
PHOTO #4: View of Supply Pier (267)
from the Naval Station



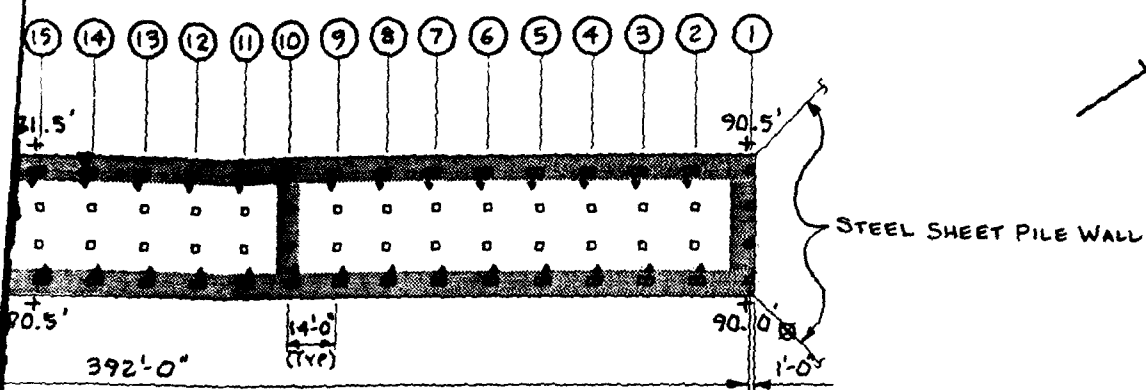
PLAN

SCALE: 1" = 40'

0' 10' 20' 30' 40'



SECTION NOT TO SCALE



AN

E: 1" = 40'

20' 30' 40'

DECK EL 108.0

MLW EL 100.0

REINFORCED CONCRETE PILE (TYP)

BOTTOM EL VARIES

LEGEND

- - VERTICAL PILE
- ▽ - BATTER PILE
- Ⓐ - VERTICAL PILE DESIGNATION (FROM USN)
- ① - BATTER PILE DESIGNATION (FROM CHESDIV STANDARDS)
- ② - BENT NO. (FROM USN)
- ⊠ - STEEL THICKNESS MEASUREMENTS TAKEN
- - CLOSELY INSPECTED PILES, REMAINING PILES
- + - NOT INSPECTED (SEE SECTION 3.2)
- 75.0' - SOUNDING (MLW)
- I - STEEL H-PILE (REPAIR PILE)
- ▼ - SIGNIFICANTLY DAMAGED PILE (SEE SECTION 4.2.2.)

GRAPHIC SCALE

AS SHOWN

CHILDS ENGINEERING
CORPORATION
BOX 888
MEDFORD, MA

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C.
NAVAL COMPLEX NOOSEVELT ROAD, VA
SUPPLY PIER (#267)

FIL NO.
6

4.2.2 Observed Inspection Condition

One pile (Pile 1, Bent 14) exhibited significant structural damage. One corner of the pile had a 5' long crack from one foot below the pile cap to the water level. It appeared that the crack extended to the main reinforcing.

Two piles, Pile D in Bent 19 and Pile A in Bent 27, were damaged. However, at some time in the past, two steel H-piles were driven on either side of each damaged concrete pile in order to carry the load, thereby repairing the damage.

In general, the remaining piles appeared to be in good condition (see Photo #5). Minor cosmetic spalling was noted in a few piles and in some sections of the concrete superstructure, but there was no evidence of softness in the concrete.

The steel sheet pile bulkhead at the base of the pier is in poor condition. Severe deterioration was evident in the splash zone (see Photo #6).

Soundings indicated that the average water depth around the pier perimeter was about 30' at mean low water.

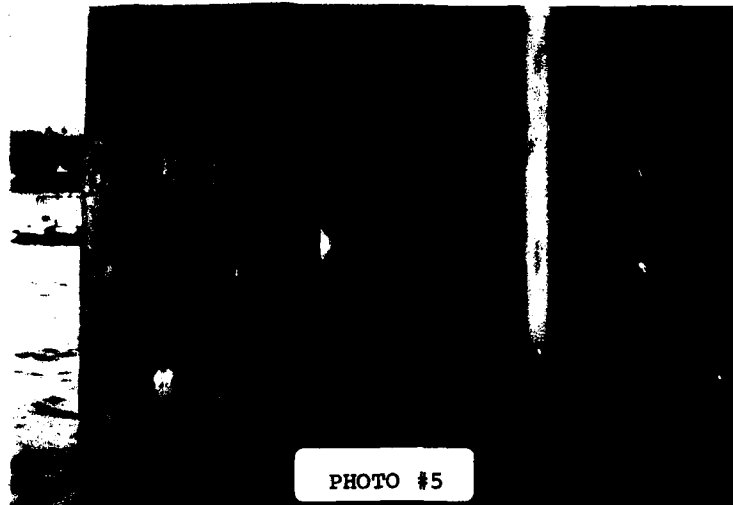
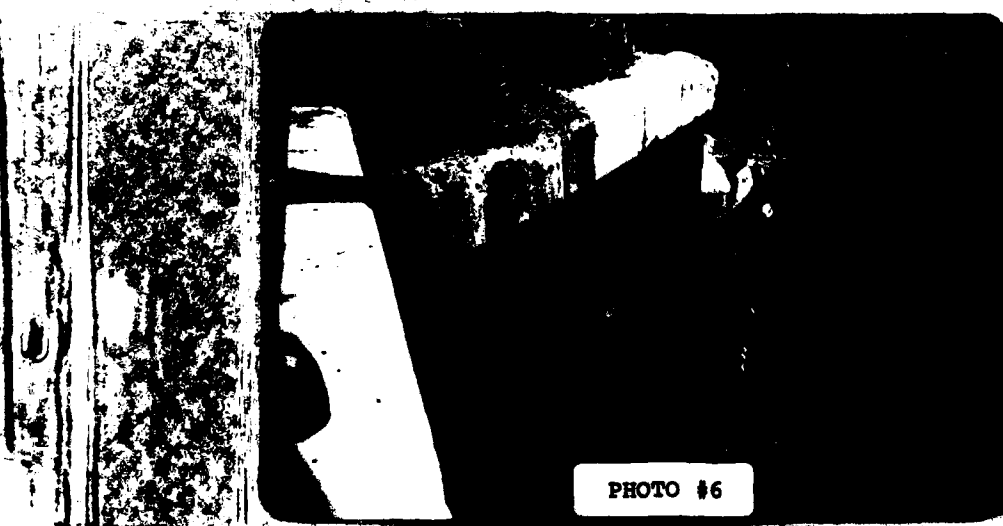


PHOTO #5: View Along Northwestern Perimeter of Supply Pier (267), Showing Typical Condition of Piles Above Mean Low Water [Photo from CHESDIV Files]

PHOTO #6: Southern Segment of Steel Sheet Pile Bulkhead at Base of Supply Pier (267), Showing Typical Corrosion in Splash Zone



4.2.3 Structural Condition Assessment

Supply Pier appears to be in good condition, and the pile foundation has sufficient capacity to handle the imposed loads. The observed cosmetic spalling and cracking in the piles are not significant, except in the case of Pile 1 in Bent 14. If this pile is left untreated, the cracked corner section of the pile will eventually spall off.

The severe deterioration of the steel sheet pile bulkhead has not created any serious structural problems as yet. However, if deterioration continues, holes will eventually appear in the steel sheet piling, causing a loss of material from behind the wall. This condition will result in the creation of voids in the area adjacent to the pier approach.

4.2.4 Recommendations

To restore Pile 1 in Bent 14 to full capacity and protect it from further deterioration, it is recommended that the existing cracked concrete be removed and the corner section be rebuilt with epoxy grout. The estimated cost for this repair is \$1,000. In addition, it is recommended that the steel sheet pile bulkhead be protected from further corrosion and deterioration by placing a reinforced concrete encasement from the base of the existing cap to elevation 97.0'. The estimated cost for this repair is \$51,000.

The Supply Pier should be reinspected in five years to document any further deterioration. This report should be used as a baseline for the future inspection.

4.3 BERTHING PIER - PIER 3 (799)

4.3.1 Description

The Berthing Pier is southeast of the Supply Pier, in the Ensenada Honda area of the Naval Station. Its base is flanked on either side by Section D of the Berthing Wharf (890). Currently, it serves as a general purpose berthing facility, although ordnance is also handled on the out-board section of the pier (see Photo #7).

The Berthing Pier was built in 1966. The 1209' long x 120' wide pier is supported by 62 bents. Bents 1 to 17, inclusive, are comprised of HP 14x73 steel piles with 26" diameter reinforced concrete jackets extending from the pile cap to around elevation 97.0'. The rest of the bents are comprised of 18" square precast, prestressed concrete piles (see Figures 7 and 8). There are a total of 68 batter and 320 vertical steel H-piles, and 132 batter and 878 vertical concrete piles. The piles are designed for a bearing capacity of 60 tons. The reinforced concrete deck is designed for a live load of 500 PSF uniform loading or highway loading of AASHO H20-S16 and a maximum lateral load of 2500 PLF.

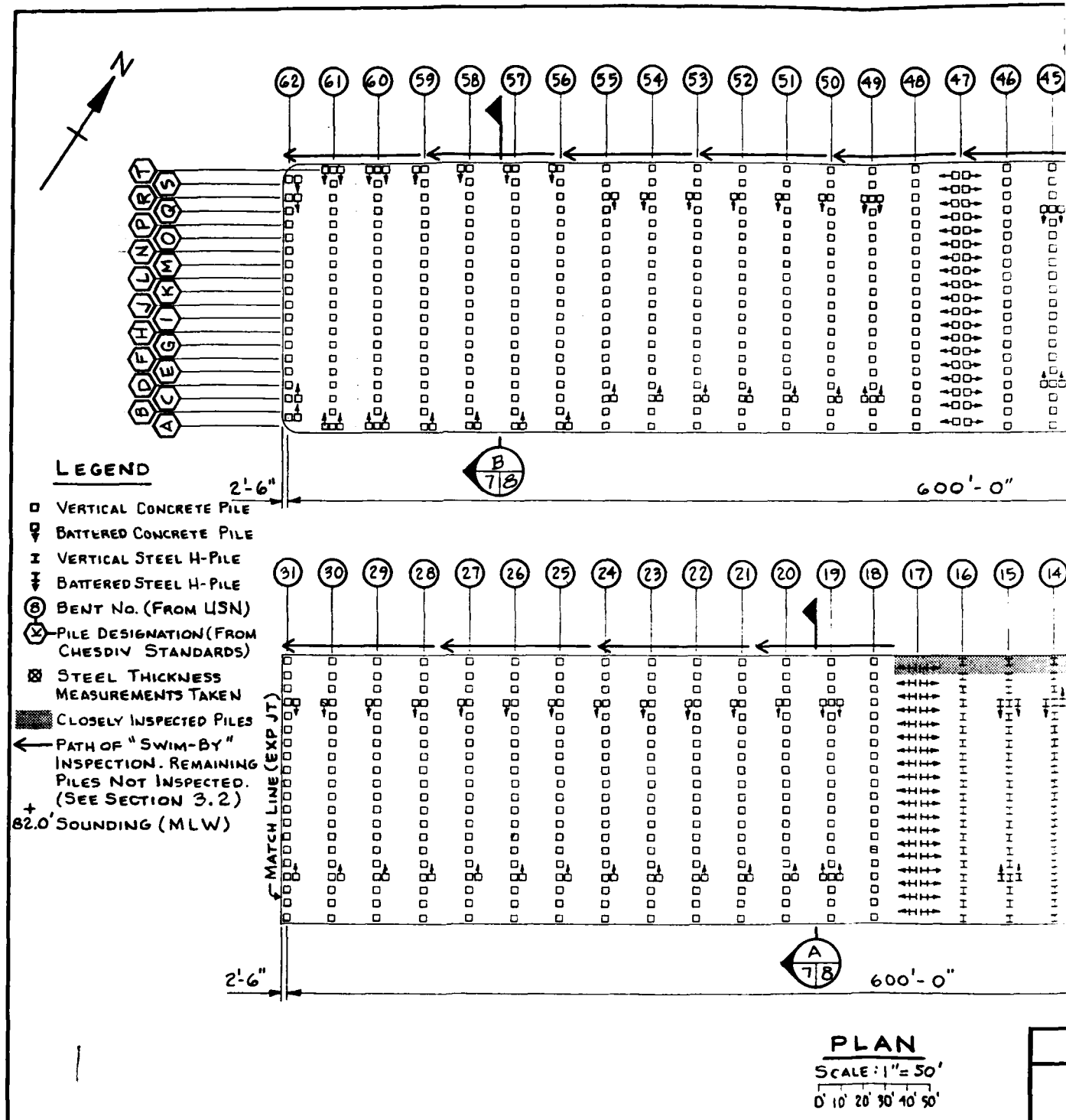
References: U.S. Naval Station - San Juan,
Bureau of Yards and Docks
"Berthing Pier"
Y & D Dwg. Nos. 1006594 and 1006597

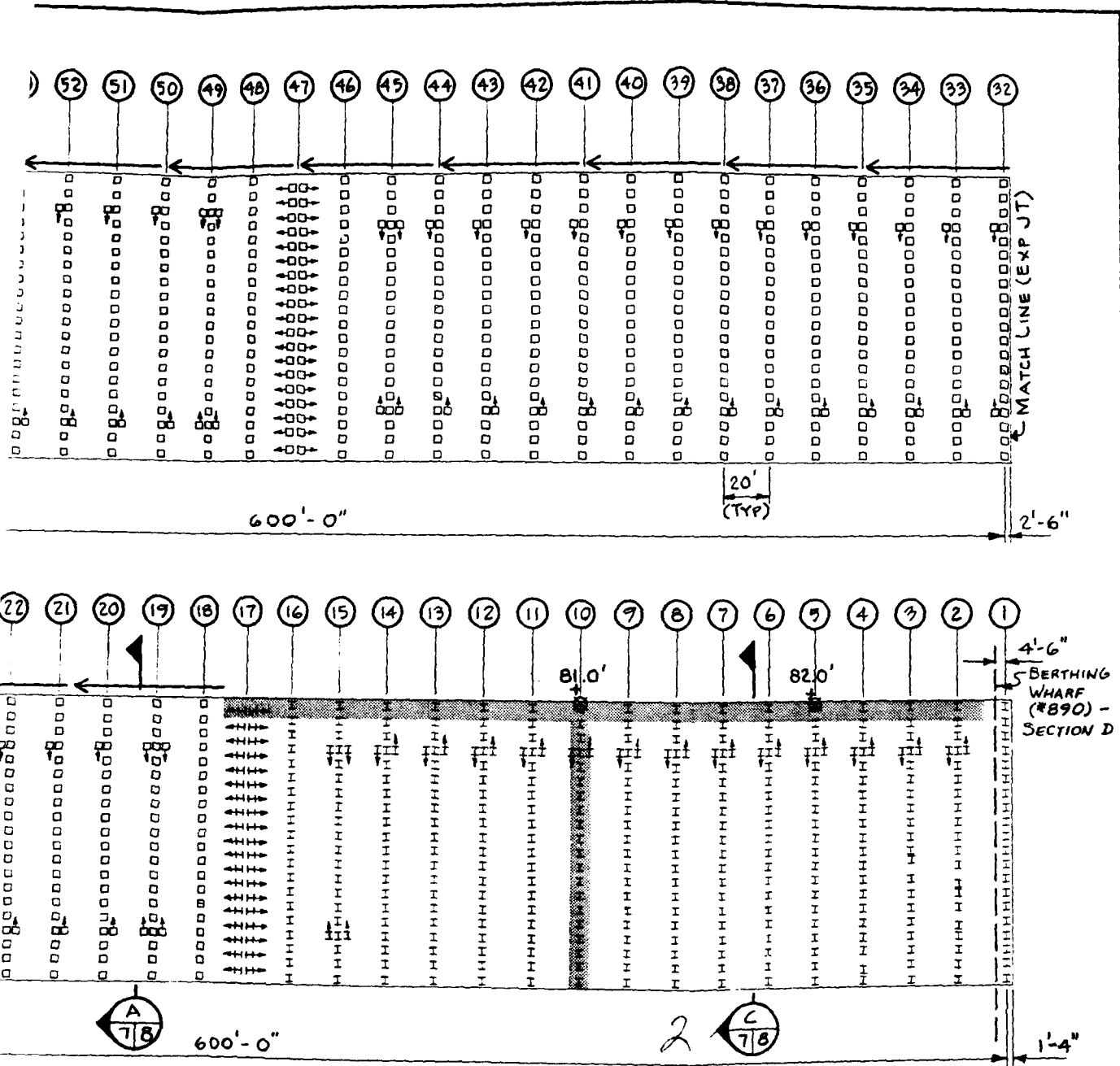
Kiewit Dredging & Construction Co.
"Berthing Pier"
Dwg. Nos. KDC-106 and KDC-108



PHOTO #7

PHOTO #7: View of Berthing Pier (799)
and Section C of Berthing
Wharf (890) from the Naval
Station

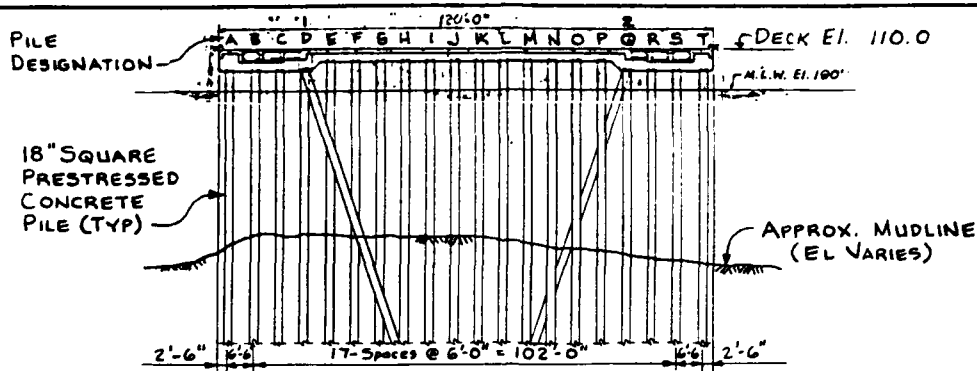




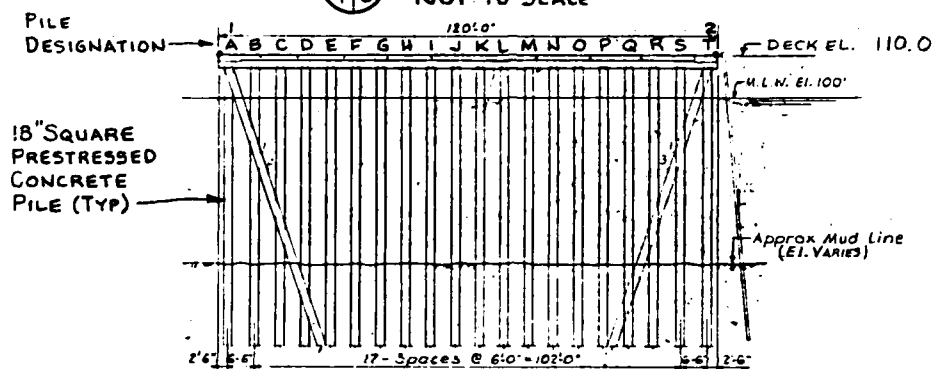
PLAN
 SCALE: 1" = 30'
 0' 10' 20' 30' 40' 50'

GRAPHIC SCALE	CHILDS ENGINEERING CORPORATION BOX 533 MEDFIELD, MA	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.	FIG. NO. 7
AS SHOWN			

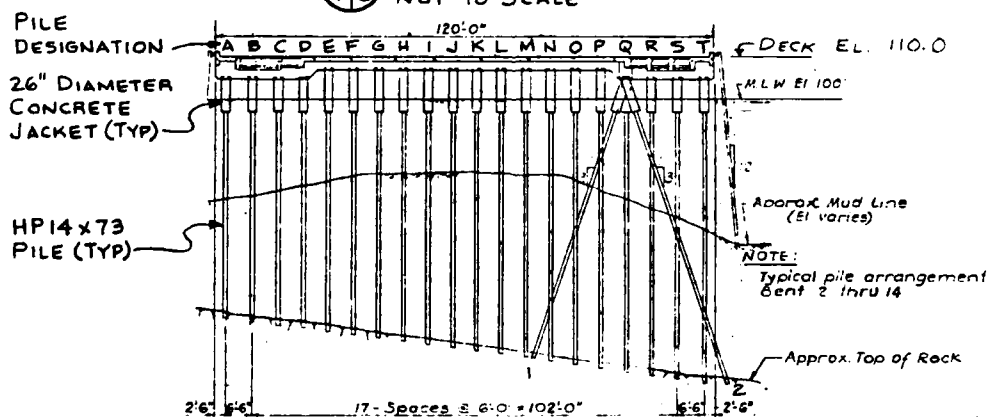
NAVAL COMPLEX ROOSEVELT ROAD, PR
BERTHING PIER (#799)



(A) SECTION
7/8 NOT TO SCALE



(B) SECTION
7/8 NOT TO SCALE



(C) SECTION
7/8 NOT TO SCALE

GRAPHIC SCALE	CHILDS ENGINEERING CORPORATION BOX 333 MEDFIELD, MA	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.	
AS SHOWN		NAVAL COMPLEX BERTHING PIER (#799)	Roosevelt Roads, PR FIG. NO. 8

4.3.2 Observed Inspection Condition

One concrete pile exhibited severe structural deterioration, probably due to impact from a berthing vessel (Pile A, specific bent unknown). The pile is completely severed just below the pile cap (see Photo #8). No major spalling, cracking or softness was observed on the remaining concrete piles (see Photo #9).

The jacketed steel piles exhibited some minor cosmetic spalling on the concrete jackets (see Photo #10). The exposed portions of the steel piles had suffered minor corrosion and exhibited some pitting (see Photo #11). Two piles were measured to determine the extent of corrosion. The average metal loss on these piles was between 2% and 4% (see Appendix for readings).

No significant deterioration was observed in the concrete superstructure.

4.3.3 Structural Condition Assessment

The Berthing Pier appears to be in excellent condition with the exception of the one damaged concrete pile. An analysis of the existing conditions indicates that the pile foundation is in satisfactory condition to handle the loads applied.

4.3.4 Recommendations

The damaged concrete pile should be repaired as soon as possible. A repair technique used successfully at the Supply Pier consists of driving two steel H-piles adjacent to the damaged concrete pile and jacketing the steel piles in concrete to protect them from corrosion. The estimated cost for this type of repair is \$16,000.

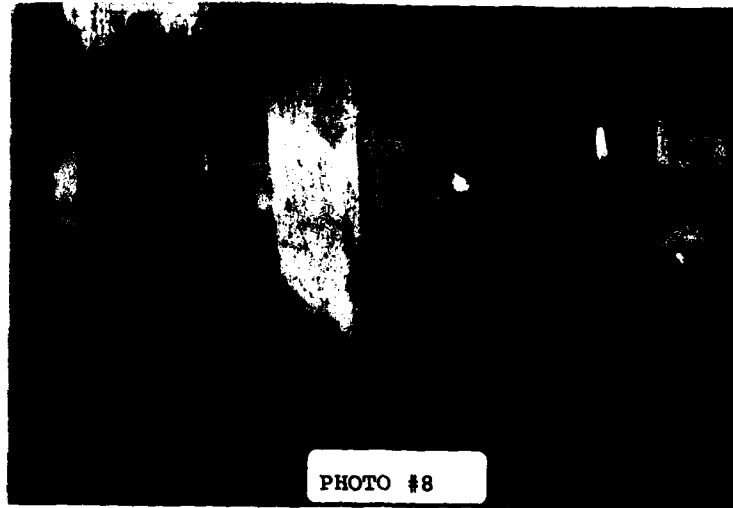


PHOTO #8

PHOTO #8: Concrete Pile in Berthing Pier
(799) Broken from Pile Cap Down
4'-5' (Pile A, Bent Unknown).
Damage Appears Due to Impact
[Photo From CHESDIV Files]

PHOTO #9: Concrete Pile in Berthing Pier
(799) Around Elevation 80.0',
Showing Typical Good Condition
of Chamfered Edge (Bent 18,
Pile T)

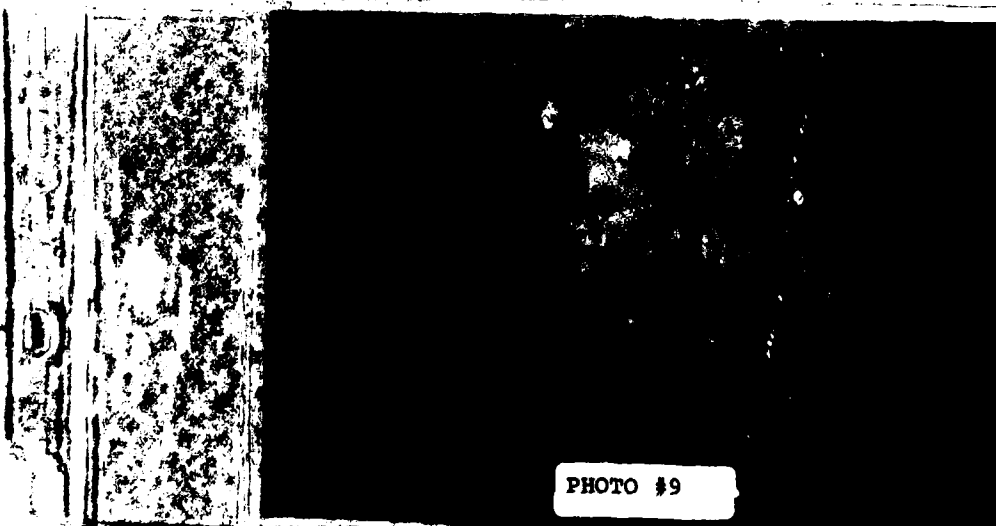


PHOTO #9



PHOTO #10

PHOTO #10: Typical Condition Above Mean Low Water of Concrete Jackets Encasing Steel H-piles in Berthing Pier (799) [Photo from CHESDIV File]

PHOTO #11: View of Edge of Flange of Steel H-pile in Berthing Pier (799) Just Below Concrete Jacket, Showing Typical Corrosion (Bent 5, Pile T)

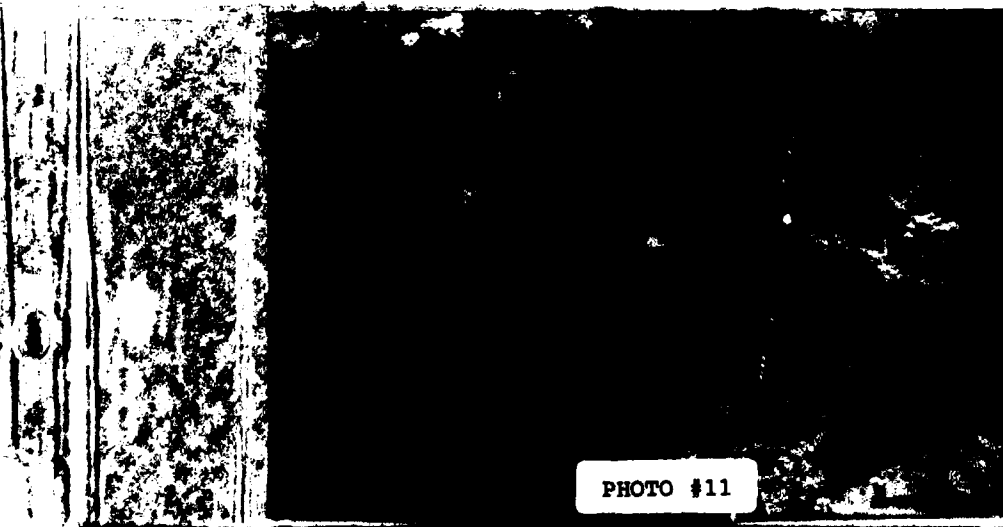


PHOTO #11

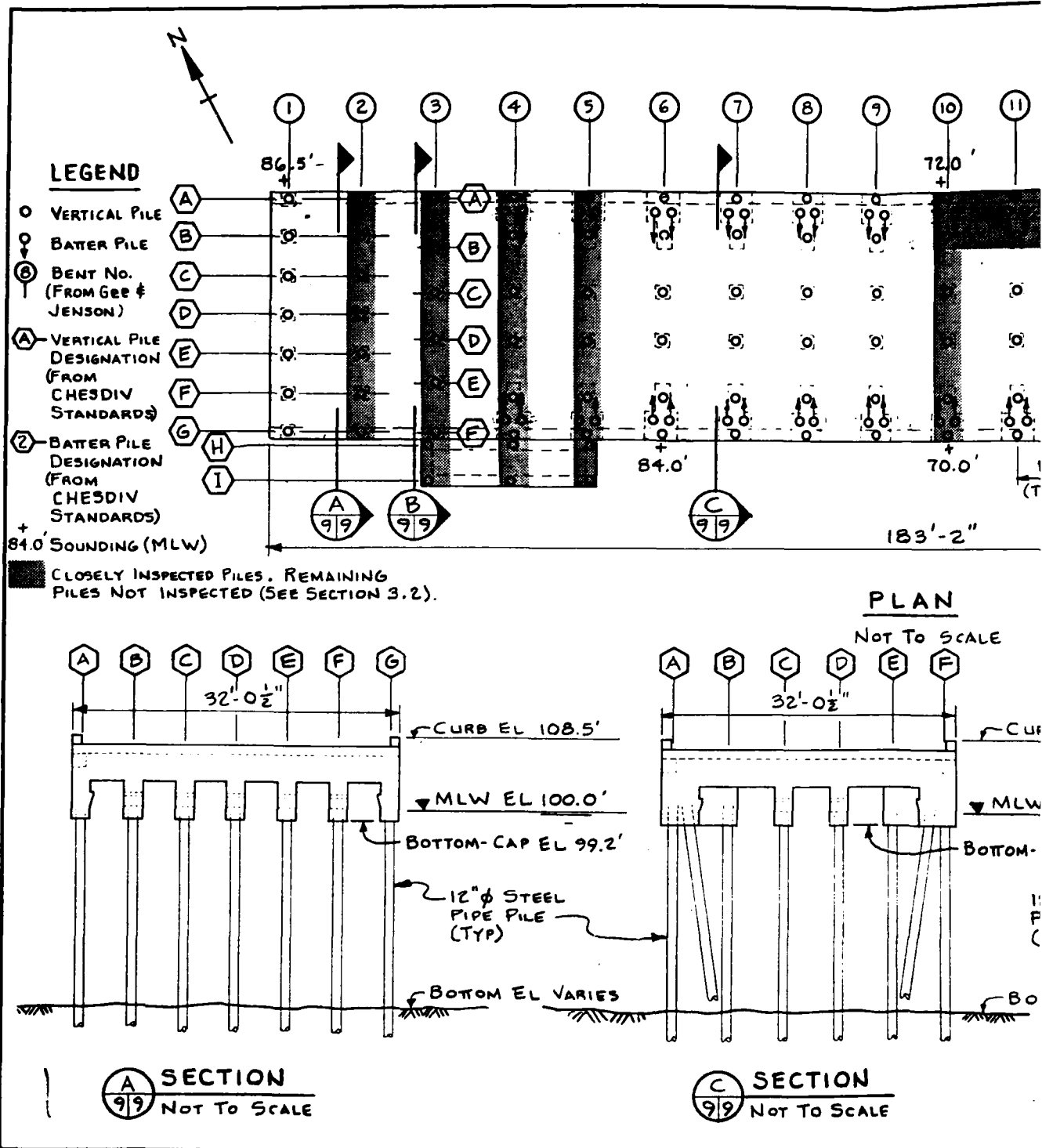
4.4 AMMUNITION PIER (277)

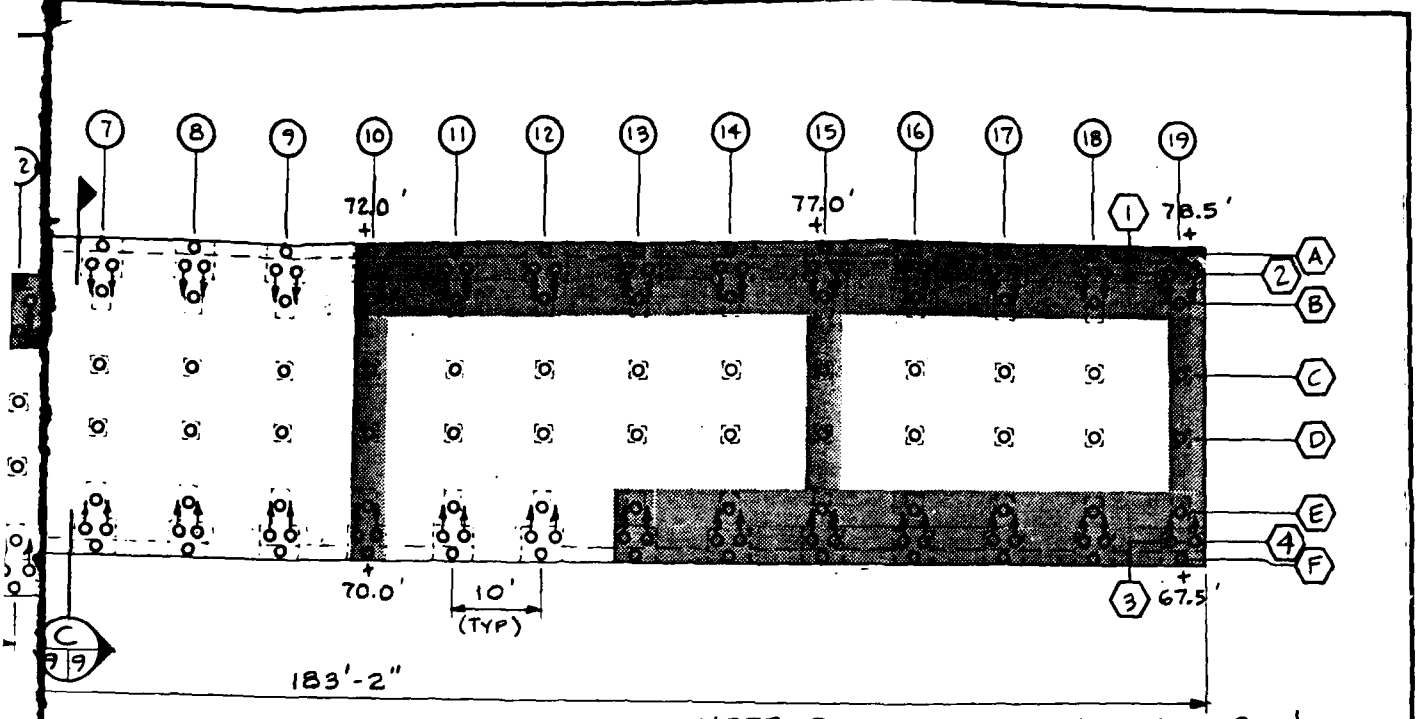
4.4.1 Description

The Ammunition Pier at the Naval Station is situated on the western edge of Ensenada Honda, isolated from the other waterfront facilities. Its location is partly due to its function, which is the handling of ordnance.

The 183' long x 32' wide pier was built in 1943. The reinforced concrete deck is supported by 19 bents with a total of 64 batter and 122 vertical bearing piles. The piles are 12" diameter steel pipe piles (see Figure 9).

References: Gee & Jenson Engineers-Architects-
 Planners, Inc.
 Subwater Inspection Report-1978.
 Job No. 78-690

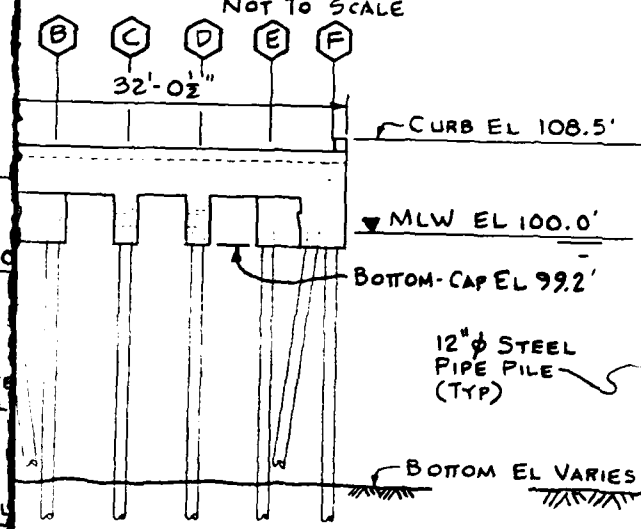




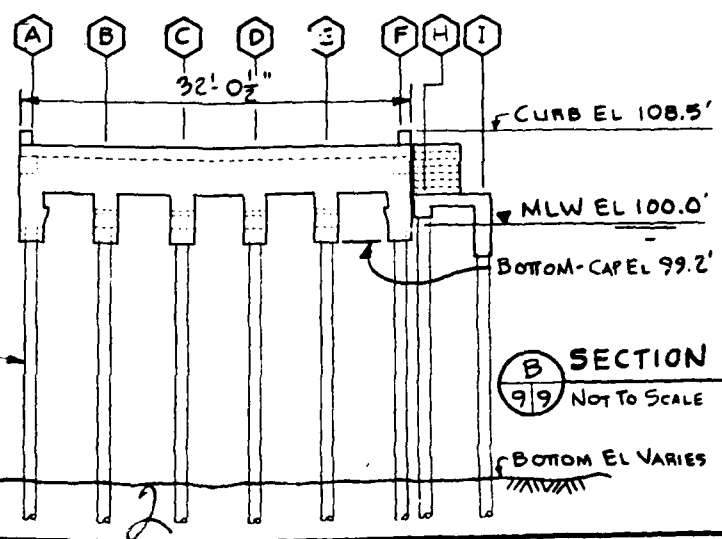
NOTE: PLAN AND SECTIONS TAKEN FROM Gee & JENSON SUBWATER INSPECTION REPORT, JOB No. 78-690.

PLAN

Not To Scale



C SECTION
9/9 Not To Scale



B SECTION
9/9 Not To Scale

GRAPHIC SCALE	CHILD'S ENGINEERING CORPORATION BOX 883 MEDFIELD, MA	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C. NAVAL COMPLEX ROOSEVELT ROAD, PM AMMUNITION PIER (#277)	FILMO. 9
AS SHOWN			

4.4.2 Observed Inspection Condition

No major structural deficiencies were noted in the pile foundation of the Ammunition Pier. All of the pipe piles exhibited deterioration as a result of corrosion. Minor pitting was noted on cleaned metal surfaces (see Photo #12). Two piles were measured to determine the extent of corrosion. The average metal loss based on these piles was approximately 10% (see Appendix for thickness readings).

The submerged portions of the concrete pile cap exhibited some softness in the concrete. In general, however, the concrete was sound. The remainder of the superstructure, including pile caps and concrete support beams, exhibited varying degrees of deterioration (see Photo #13). Many areas of the concrete were spalled and, in some cases, reinforcing was exposed and rusting.

Soundings taken along the perimeter of the pier indicated that the average water depth was approximately 30' at mean low water along the south side of the pier and approximately 25' at mean low water along the north side.

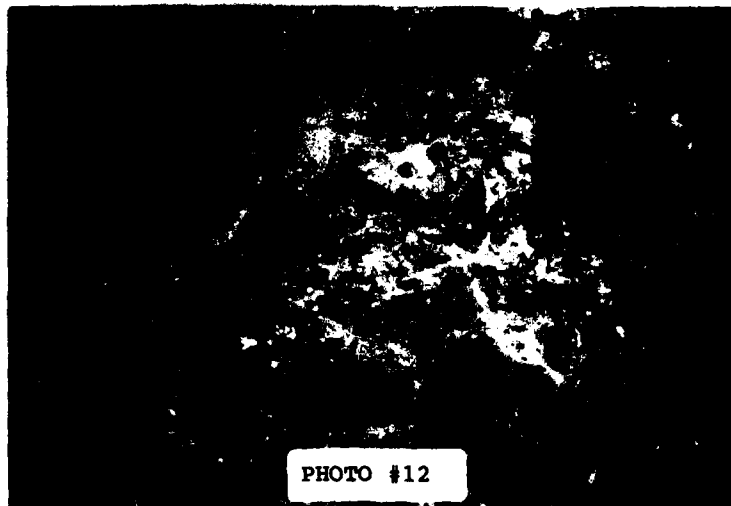


PHOTO #12: Cleaned Area on Steel Pipe Pile
in Ammunition Pier (277) Just
Below Pile Cap, Showing Typical
Corrosion (Bent 15, Pile A)

PHOTO #13: View of Pile Caps and Beams in
Bent 6 of Ammunition Pier (277),
Showing Typical Condition of
Concrete



4.4.3 Structural Condition Assessment

The pile foundation of the Ammunition Pier is in satisfactory condition and is capable of handling the applied loads. The observed spalling and deterioration of the concrete superstructure is not sufficient to detract from its structural capability. However, if left unchecked, this deterioration will continue and eventually reduce the capacity of the pier deck structure.

4.4.4 Recommendations

No repairs to the pile foundation are needed at this time. It is recommended, however, that further inspection of the pier superstructure be performed to determine the extent of repairs which may be required to preserve the maximum capacity of the deck structure. The Ammunition Pier should be reinspected in five years to document any deterioration. This report should be used as a baseline for this future inspection.

4.5 BERTHING WHARF - SECTIONS A,B,C & D (890)

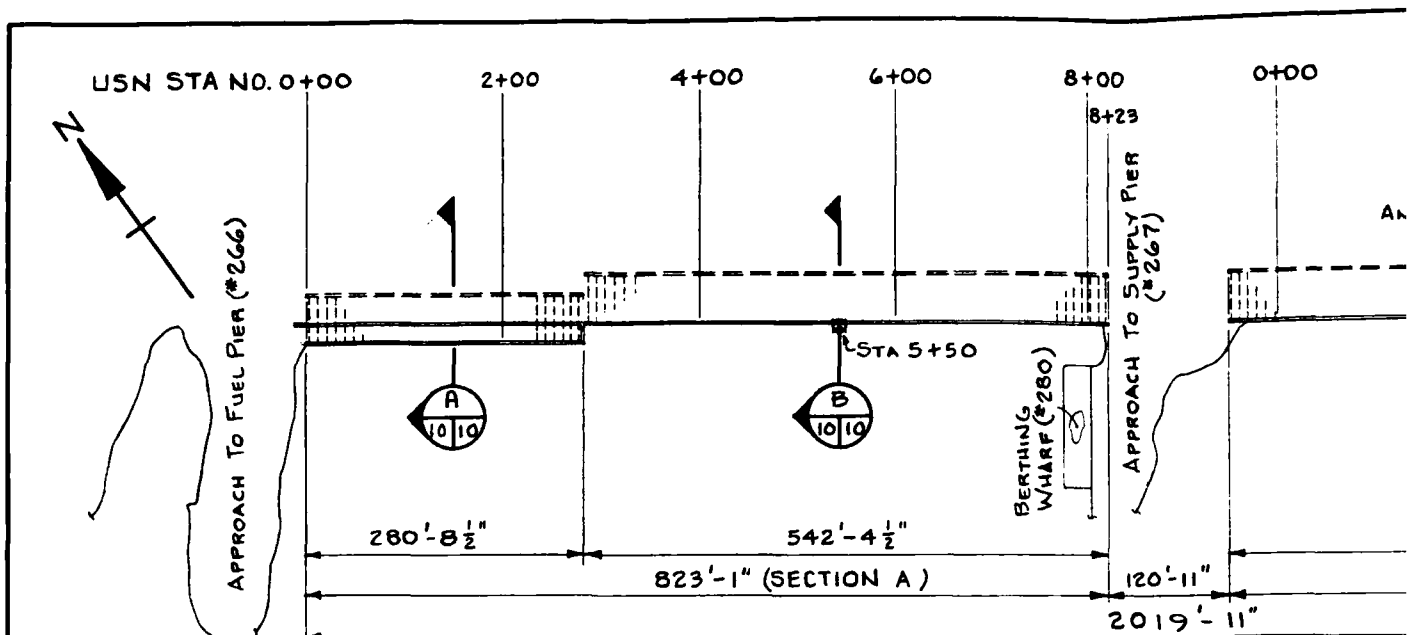
4.5.1 Description

The Berthing Wharf, which is actually a steel sheet pile bulkhead, is divided into four sections that run along the shoreline of the Naval Station from the Fuel Pier in the northwest to a short distance beyond the Berthing Pier in the southeast. The bulkhead is used for general purpose berthing.

The 3,738' long x 12' wide Berthing Wharf is a bulkhead that was built in 1965 and is composed for four distinct sections. Section A is 823' long and runs between the Fuel Pier and the Supply Pier. Section B is 1,000' long and runs in a southeast direction from the Supply Pier to a 90° corner made by the LST Ramp (843). Section C is 813' long and runs southwest from the LST Ramp. At the end of Section C, the wall makes a 68° turn to the southeast. This is Section D, which is 1,101' long. It runs under the Berthing Pier and beyond before making a change in direction. The last 227' of the section, which were not inspected, run in a northerly direction (see Figures 10 and 11).

The bulkheads are anchored steel sheet pile walls constructed of Z sections. According to government-furnished information, the steel sheet piling are mainly Z-27 sections. The exception to this is a 217'-long segment of Section C (between CEC Stations 7+60 and 5+40) that is shown to be composed of Z-38 sections. For most of its length, the Berthing Wharf is capped and encased by reinforced concrete down to elevation 98.0' (see Photo #14). The design stress for the tie rods, wales and sheet piles is 22,000 PSI.

References: U.S. Naval Station - San Juan,
Bureau of Yards and Docks
"Dredging of Ensenada Honda"
Y & D Dwg. Nos. 964419, 964420,
1041273 and 1041274

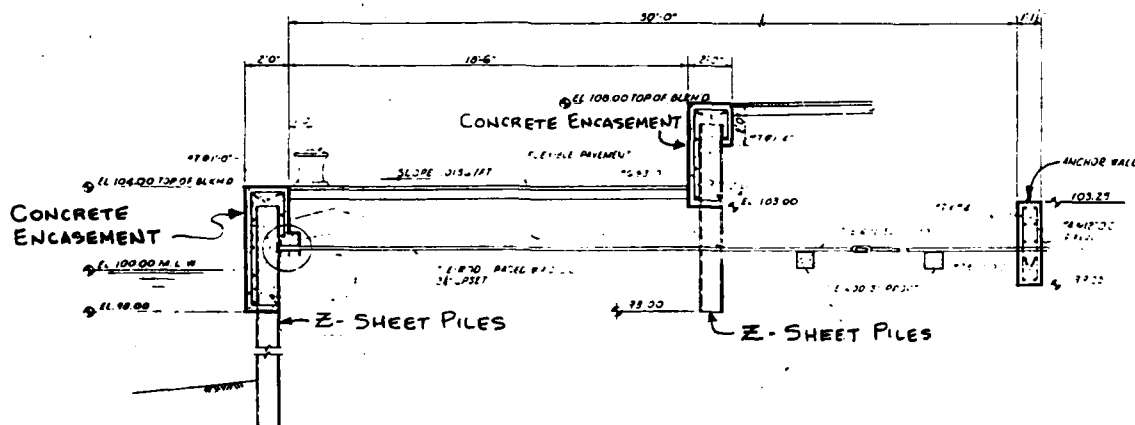


LEGEND

■ STEEL THICKNESS MEASUREMENTS TAKEN.

PLAN

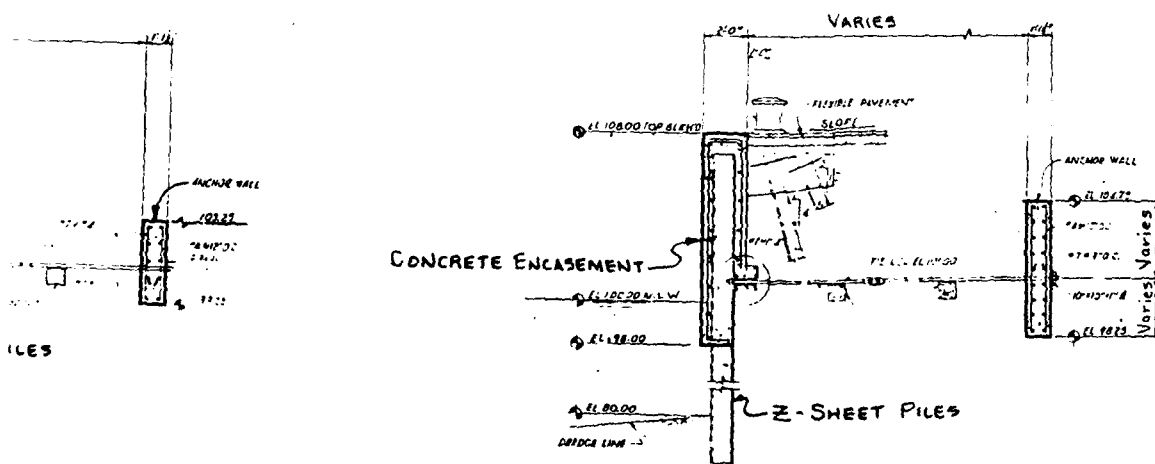
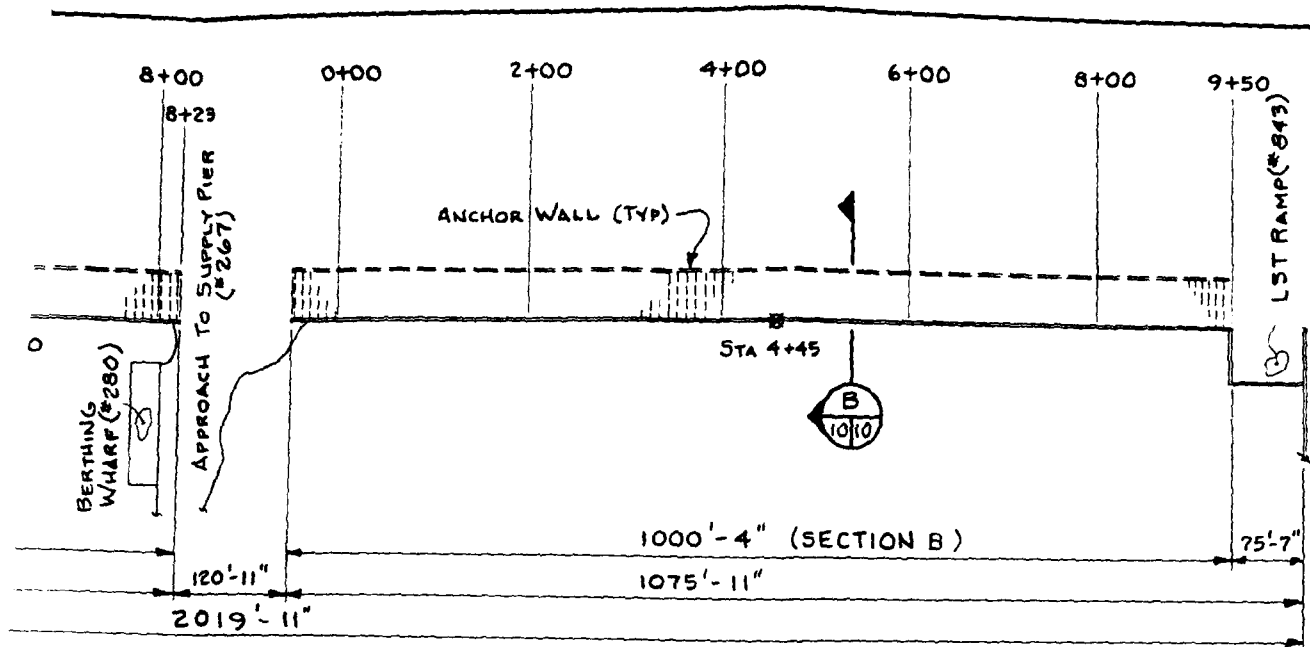
NOT TO SCALE



SECTION A

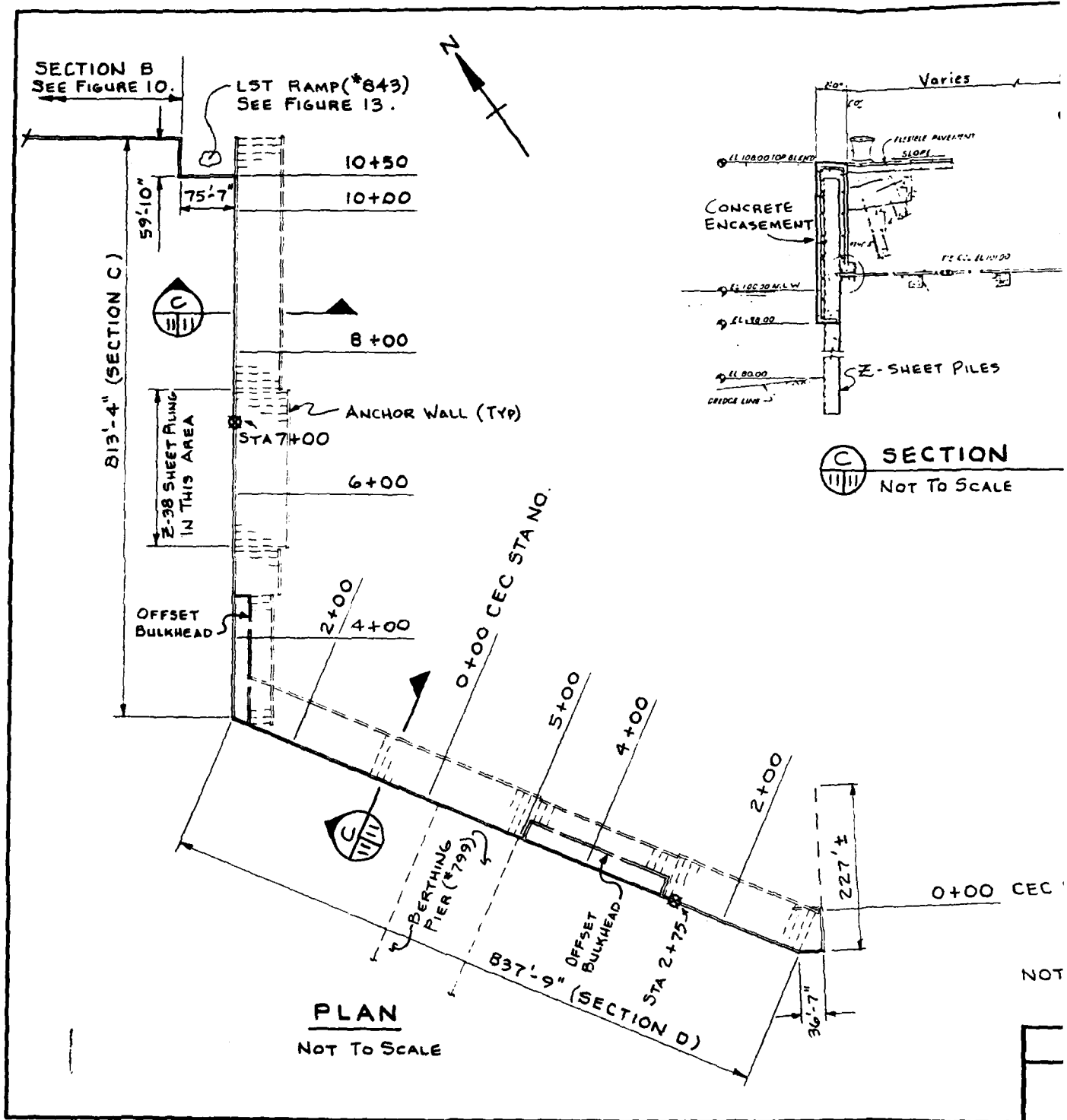
NOT TO SCALE

- NOTE:**
- 1) SECTIONS TAKEN FROM Y&D DWG NOS. 1041273 AND 1041274.
 - 2) ALL OF THE BULKHEAD CLOSELY INSPECTED. (SEE SECTION 3.2)



1273 AND 1041274.
(SEE SECTION 3.2)

GRAPHIC SCALE	CHLDS ENGINEERING CORPORATION BOX 333 MEDFIELD, MA	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.	
AS SHOWN		NAVAL COMPLEX ROOSEVELT ROAD, PM BERTHING WHARF (#890) SECTIONS A & B	FIG. NO. 10





☒ STEEL THICKNESS MEASUREMENTS TAKEN.



GRAPHIC SCALE	CHILDS ENGINEERING CORPORATION BOX 393 MEDFIELD, MA	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.	
		NAVAL COMPLEX ROOSEVELT ROADS, PM BERTHING WHARF #390 SECTIONS C & D	FIG. NO. 11
AS SHOWN			

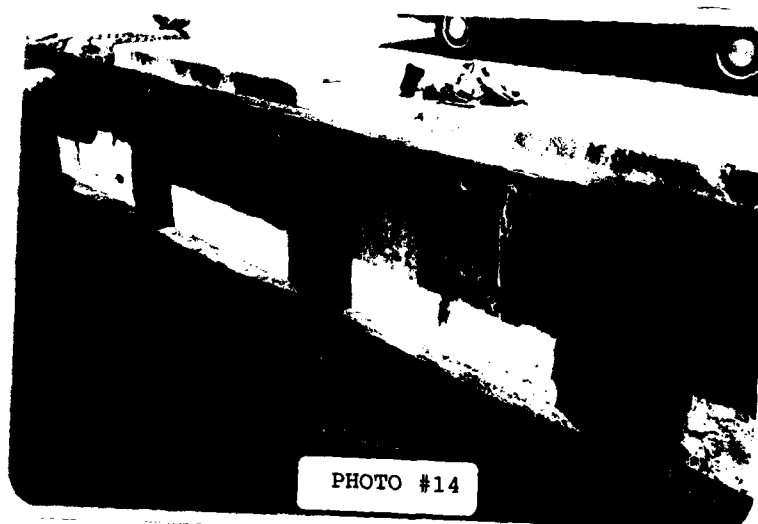


PHOTO #14: View of Concrete Encasement
and Fender System in Section A
of the Berthing Wharf (890),
Showing Typical Conditions

4.5.2 Observed Inspection Condition

Except for some occasional cosmetic spalling and softness at the base of the concrete encasement, no unusual conditions or damage was observed. In general, the concrete encasement was sound (see Photo #14).

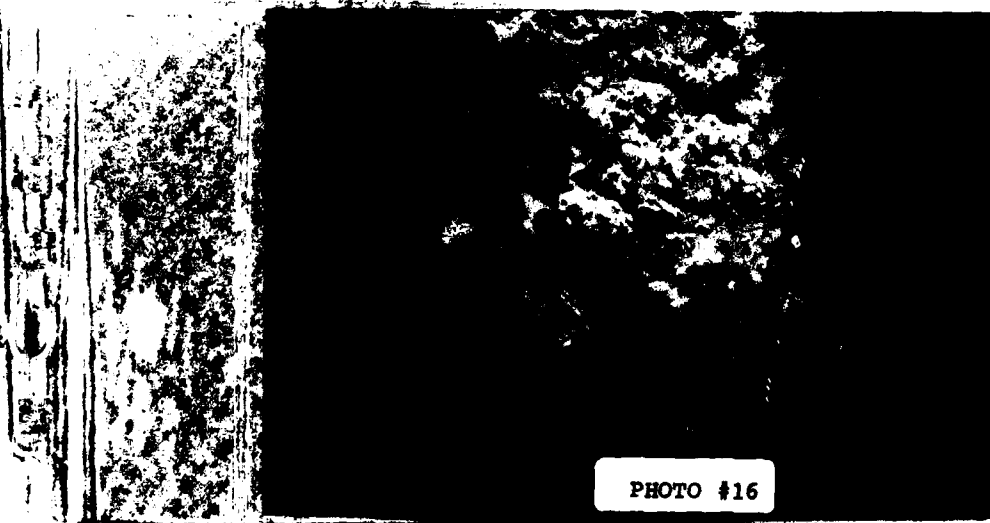
The steel sheet piling have deteriorated slightly. Some areas of pitting were noted on cleaned metal surfaces (see Photo #15). Corrosion nodes were located sporadically along the entire bulkhead face (see Photo #16). At one station within each section of the wharf, a steel sheet pile was measured to determine the extent of corrosion. The average metal loss based on these four piles was between 2.5% and 9% (see Appendix for actual readings).

Soundings taken along the Berthing Wharf face indicated that water depths ranged from 12' to 20' at mean low water.



PHOTO #15: Cleaned Patch Just Below
Concrete Encasement in Section
C of Berthing Wharf (890),
Showing Typical Corrosion
(CEC Station 7+00)

PHOTO #16: Example of Corrosion Node in
Section A of Berthing Wharf
(890) at Mudline (USN Station
5+50)



4.5.3 Structural Condition Assessment

The Berthing Wharf is in excellent condition. No structural abnormalities or significant deterioration was observed which would reduce the bulkhead's capacity.

4.5.4 Recommendations

No repairs are needed at this time. It is recommended that a detailed inspection of the tieback system, including tie-rods and associated fasteners, be performed in order to assess their condition and determine if they are capable of handling the imposed loads. The Berthing Wharf should be reinspected in five years to document any further deterioration. This report should be used as a baseline for future inspections.

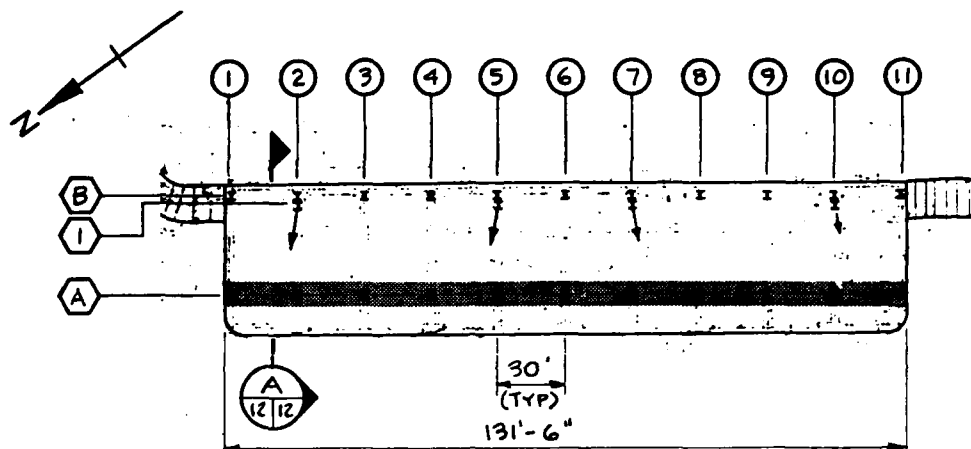
4.6 BERTHING WHARF (280)

4.6.1 Description

This Berthing Wharf is located just north of the base of the Supply Pier in the Naval Station. It functions as a berthing area for the Station's service craft.

The present Berthing Wharf was built in 1957 and is 131.5' long x 30' wide. The reinforced concrete deck is supported by 11 bents with a total of 4 batter and 22 vertical bearing piles. The vertical piles are all steel HP 12x74 sections. Two of the batter piles are steel HP 12x53 sections (Bents 7 and 10) and the other two are steel WF 12x65 sections (see Figure 12). The batter piles and inshore vertical piles are completely covered by rock fill. The outshore vertical piles (the A piles) are exposed and are encased in 18" square reinforced concrete jackets from the pile cap to elevation 98.5'. The piles are designed for a bearing capacity of 70 tons.

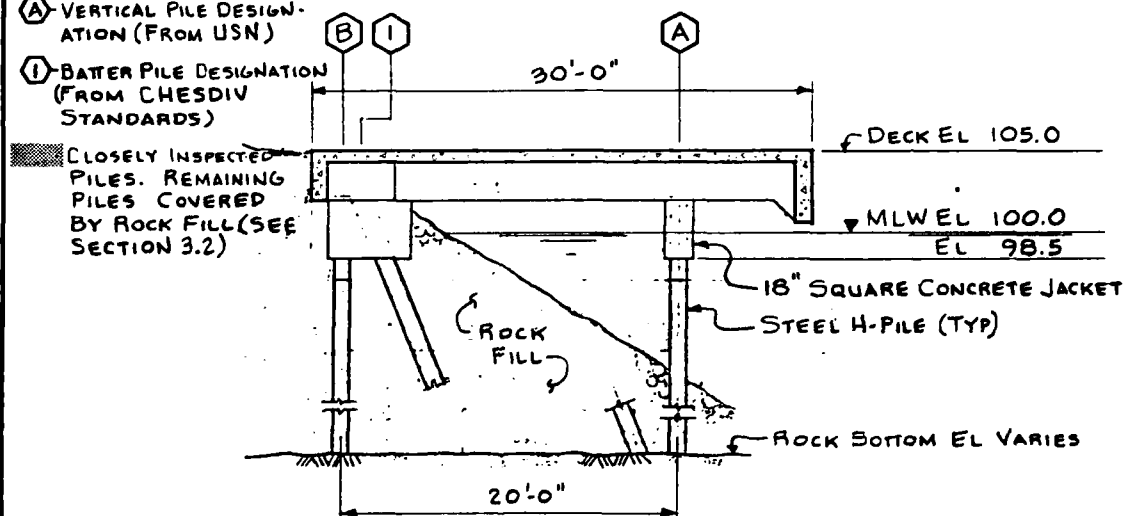
References: Tenth Naval District, Bureau of
Yards and Docks
"Yard Craft Berth"
Y & D Dwg. No. 784244



LEGEND

- I VERTICAL PILE
- ⊥ BATTER PILE
- ② BENT No. (FROM USN)
- Ⓐ VERTICAL PILE DESIGNATION (FROM USN)
- Ⓛ BATTER PILE DESIGNATION (FROM CHESDIV STANDARDS)

PLAN NOT TO SCALE



SECTION NOT TO SCALE

NOTE: PLAN AND SECTION TAKEN FROM Y&D
DWG. No. 784244.

<p>GRAPHIC SCALE</p> <p>AS SHOWN</p>	<p>CHILDS ENGINEERING CORPORATION 502 833 MEDFORD, MA</p>	<p>CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.</p> <p>NAVAL COMPLEX ROOSEVELT ROAD, PR BERTHING WHARF (#280)</p> <p>PIN. NO. 12</p>
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4.6.2 Observed Inspection Condition

No significant deterioration of the concrete superstructure was noted. Reinforced concrete jackets were also sound. Exposed sections of the steel H-piles exhibited some minor corrosion at the edges of the flanges (see Photo #17). However, coating was intact over most of the exposed surfaces of the piles.

4.6.3 Structural Condition Assessment

The Berthing Wharf is in excellent condition. No structural deterioration was observed which would reduce the capacity of the piles.

4.6.4 Recommendations

No repairs are needed at this time. The Berthing Wharf should be reinspected in ten years to document any deterioration. This report should be used as a baseline for future inspections.

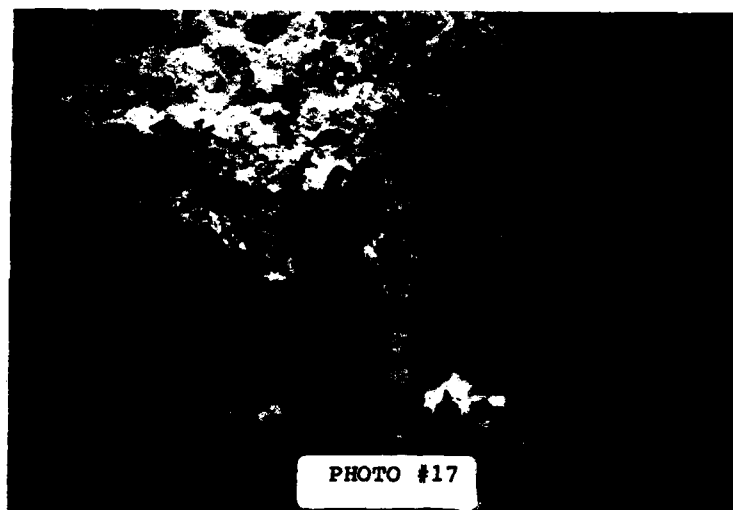


PHOTO #17: Typical Condition of Edge of
Flange of Steel H-pile in
Berthing Wharf (280) Just Below
Concrete Jacket (Bent 11, Pile A)

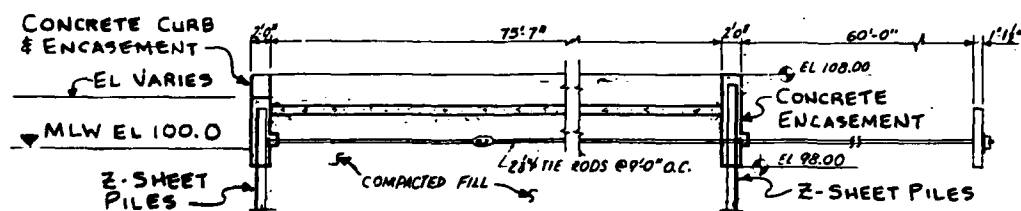
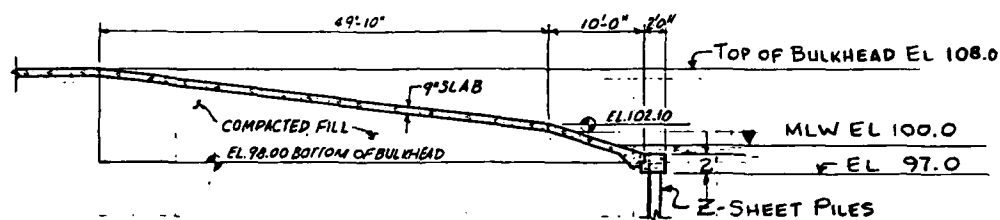
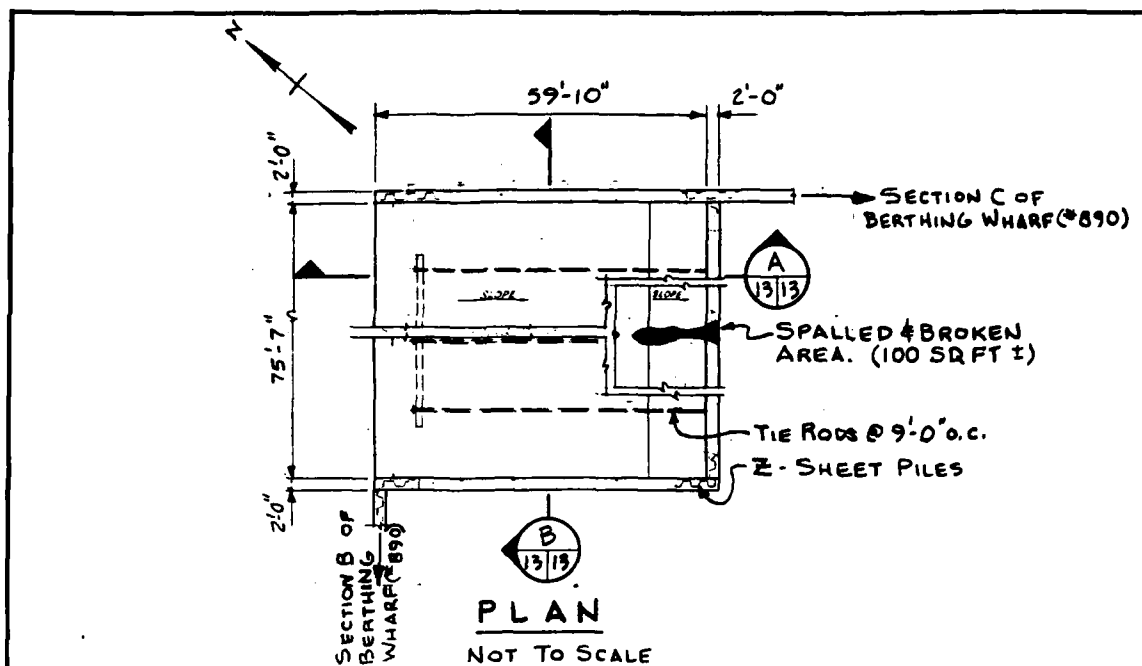
4.7 LST RAMP (843)

4.7.1 Description

The LST Ramp is located at the Naval Station between the Supply Pier and the Berthing Pier, in the corner between Sections B and C of the Berthing Wharf (890). The ramp is used as a general landing area for harbor utility craft (YFU) and tank landing ships (LST).

The 62' long x 80' wide ramp was built in 1963. It is comprised of a perimeter, anchored steel sheet pile bulkhead filled with compacted granular material. The ramp itself is a cast-in-place, reinforced concrete slab placed on the granular fill (see Figure 13). The steel sheet pile wall is constructed of Z-27 sections.

References: U.S. Naval Station - San Juan,
Bureau of Yards and Docks
"Dredging of Ensenada Honda"
Y & D Dwg. No. 964421



NOTE: 1.) PLAN AND SECTIONS TAKEN FROM Y&D DWG No 964421.
2.) RAMP AND BULKHEAD CLOSELY INSPECTED FROM MLW DOWN (SEE SECTION 3.2).

GRAPHIC SCALE	CHILDS ENGINEERING CORPORATION BOX 881 MEDFIELD, MA	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.	FIG. NO.
AS SHOWN		NAVAL COMPLEX ROOSEVELT ROAD, PR LST RAMP (#843)	13

4.7.2 Observed Inspection Condition

In the midsection of the LST Ramp, running from the lip of the ramp back approximately 14', the reinforced concrete slab was cracked and broken. The damaged area ranged from 1' to 4' in width, and the concrete was broken through to the underlying fill and steel sheet piling.

The outshore edge of the reinforced concrete ramp was deteriorated along its face. In some areas spalling extended 6" - 7" in, and the reinforcing was exposed. The remainder of the submerged portion of the concrete ramp appeared sound. Some surface deterioration was noted, but it was cosmetic.

The steel sheet piling around the perimeter of the ramp exhibited minor deterioration as a result of corrosion. Its condition was consistent with the steel sheet piling in Sections A-D of the Berthing Wharf (890).

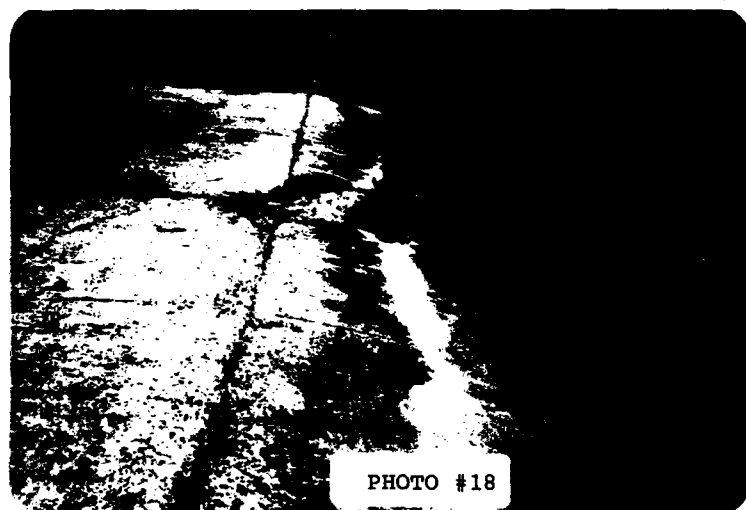


PHOTO #18: Spalled and Broken Area of
Concrete Slab in Center of
LST Ramp (843)

4.7.3 Structural Condition Assessment

Although the spalled concrete and associated deterioration of the ramp do not appear to have affected the use of the facility, tidal action will continue to wash out underlying gravel, creating cavities under the concrete slab. If high loads, such as fuel truck wheel loads, are imposed on these areas, the concrete will eventually give way, and use of the ramp will have to be restricted.

4.7.4 Recommendations

The deteriorated section of the concrete slab should be repaired as soon as possible. The spalled and broken portion should be cleaned of all loose concrete and a new reinforced concrete slab should be cast in the cleaned area. To insure that no voids remain under the concrete slab, pressure grouting should be performed in the area of the crack. In addition, the submerged face of the ramp should be protected against further deterioration. Spalled concrete and exposed reinforcing should be cleaned and patched with epoxy mortar. The estimated cost of these repairs is \$16,000.

The ramp should be reinspected in five years to determine if further deterioration has taken place. This report should be used as a baseline for future inspections.

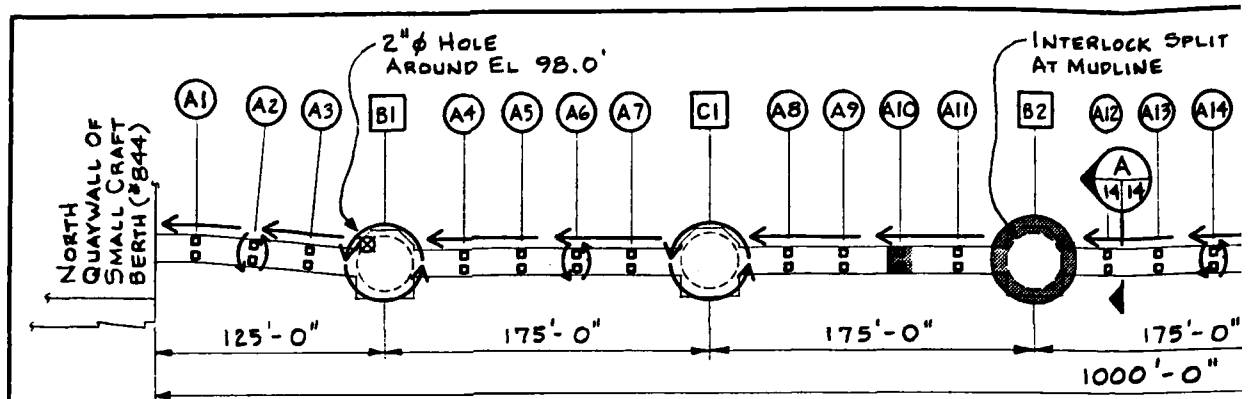
4.8 APPROACH PIER (273)

4.8.1 Description

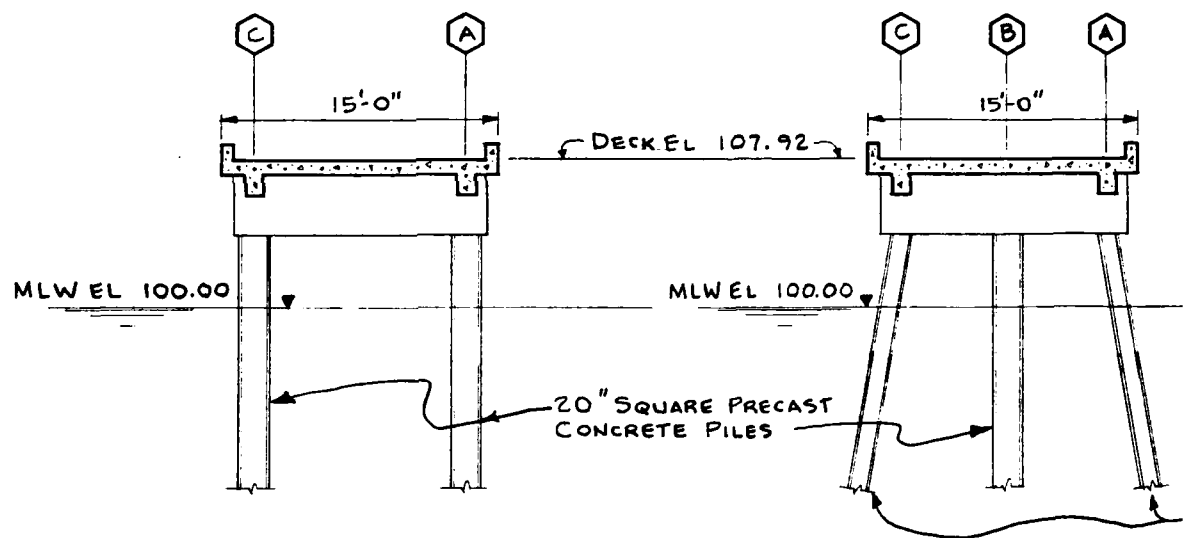
The Approach Pier is situated in the Naval Station on Puerca Bay, which is east of the main harbor area of Ensenada Honda. The pier base joins the North Quaywall of the Small Craft Berth (844), which borders one side of the mouth of Dry Dock No. 1. The use of this facility is currently restricted due to the deteriorated condition of the decking and the lack of fendering.

The Approach Pier was built in 1944. The 1,018' long x 15' wide pier is supported by six rock-filled steel sheet pile cylinders and 23 bents (see Figure 14). The cylinders are 30' - 6 5/8" in diameter and are constructed of M-112 sections. The bents are composed of 38 20"-square precast, reinforced concrete piles and 16 steel HP 14x89 piles. The concrete piles have a design bearing capacity of 50 tons. The reinforced concrete deck has a design live load of 200 PSF uniform loading.

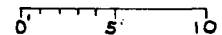
References: Naval Operating Base,
Roosevelt Roads, Puerto Rico
"Approach to Dry Dock"
P.W. Dwg. No. 1927



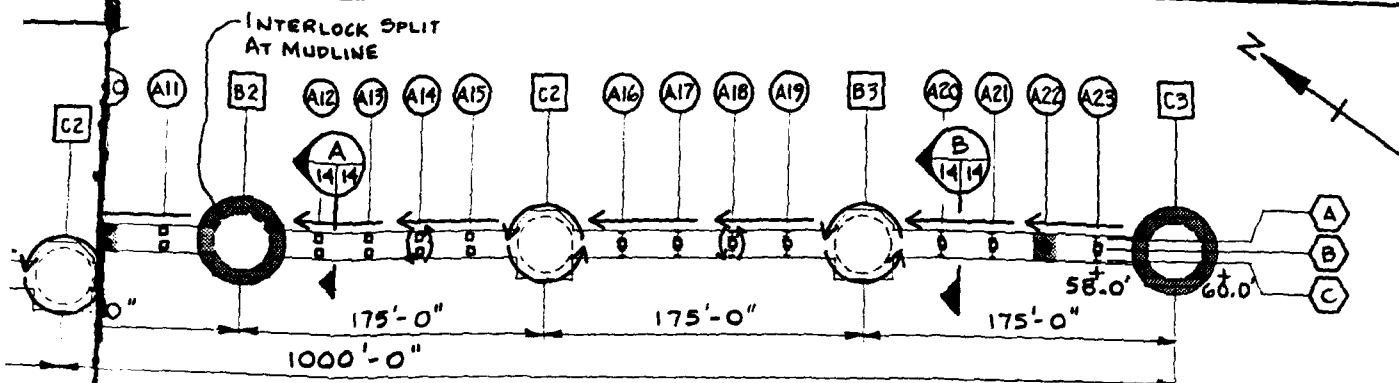
PLAN
SCALE: 1" = 10'



A SECTION
SCALE: $\frac{1}{8}" = 1'-0"$



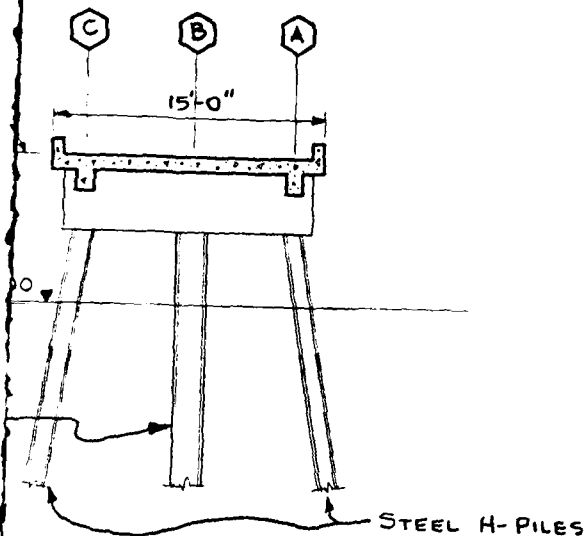
B SECTION
SCALE: $\frac{1}{8}" = 1'-0"$



PLAN
SCALE: 1" = 80' 0' 50' 80' 100'

LEGEND

- VERTICAL CONCRETE PILE
- ⌢ STEEL H-PILE
- (A) BENT NO. (FROM USN).
- (C2) STEEL SHEET PILE CYLINDER NO. (FROM USN).
- (B) PILE DESIGNATION (FROM CHESDIV STANDARDS).
- CLOSELY INSPECTED PILES
- ← PATH OF "SWIM-BY" INSPECTION. REMAINING PILES NOT INSPECTED (SEE SECTION 3.2).
- ⊗ STEEL THICKNESS MEASUREMENTS TAKEN.
- + 60.0' SOUNDING (MLW)



SECTION
SCALE: 1/8" = 1'-0"

GRAPHIC SCALE

AS SHOWN

CHILDS ENGINEERING
CORPORATION
BOX 888
MEDFIELD, MA

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C.
NAVAL COMPLEX ROOSEVELT ROAD, PR
APPROACH PIER (#273)

FIG. NO.
14

4.8.2 Observed Inspection Condition

The concrete piles which support the reinforced concrete deck between the steel sheet pile cylinders exhibited some softness around mean low water. The steel H-piles at the outshore end of the Approach Pier exhibited minor to moderate corrosion. The steel sheet pile cylinders exhibited severe deterioration around mean low water and in the splash zone (see Photo #19; see Appendix for thickness readings). Holes were evident in the splash zone area and could be created in the area just below mean low water with the aid of a chipping hammer (see Photo #20 and Figure 14). At Cylinder B2, a split interlock was found, extending from the mudline up 4' (see Figure 14). A void was noted through the split indicating that a substantial amount of fill material had been lost from the cylinder.

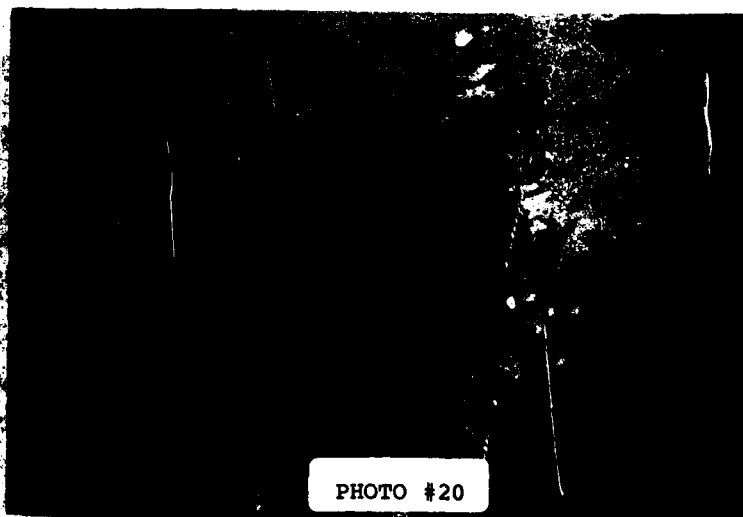
In general, the reinforced concrete pile caps associated with the pile bents exhibited moderate spalling, and some reinforcing was exposed. The reinforced concrete superstructure, including deck and deck support beams, also exhibited minor to moderate spalling along their lower edges.

Soundings taken along the perimeter of the pier indicated that the average water depth was approximately 40' at mean low water.



PHOTO #19: View of Deck and Cylinder B1,
Looking Inshore Along Northeast
Edge of the Approach Pier (273).
Note Corrosion of Steel Sheet
Piling in Splash Zone (Typical
Condition)

PHOTO #20: A 2" Diameter Hole Around
Elevation 98.0' in Steel Sheet
Piling on North Side of Cylinder
B1 in the Approach Pier (273)



4.8.3 Structural Condition Assessment

The concrete and steel piles supporting the Approach Pier are in fair shape and have sufficient capacity to support the applied loads. Although severe deterioration is evident in the tidal zone and splash zone on the steel sheet pile cylinders, the steel below the mean low water area is in fair condition. The cylinders are therefore not in excessively deteriorated condition from a structural standpoint. However, if the severely corroded areas around mean low water and in the splash zone are not repaired, fill material would be lost through holes formed in the sheet piling. This condition could eventually result in distortion and failure of the upper section of the cylinders.

4.8.4 Recommendations

Government-furnished information indicates that the use of this facility is restricted. It therefore seems safe to conclude that the condition of the pier is well-known. If it is determined that this facility is no longer necessary, it should be removed before it deteriorates to the point of collapse, as the occurrence of an uncontrolled failure would necessitate a much more extensive demolition operation. It is estimated that the cost to demolish the pier would be approximately \$200,000.

If the pier is to be rehabilitated, the existing reinforced concrete pile caps should be cleaned to sound concrete and patched with epoxy mortar to prevent further deterioration. The steel sheet pile cylinders must be protected from the existing concrete cap to elevation 97.0'. A ring of new coated steel sheet piling should be suspended from the cap of each cylinder to elevation 97.0', and the gap between the new sheeting and existing sheeting should be filled with reinforced concrete. The split in Cylinder B2 should be repaired by covering the area with a steel plate. The estimated cost of these repairs is \$1,200,000.

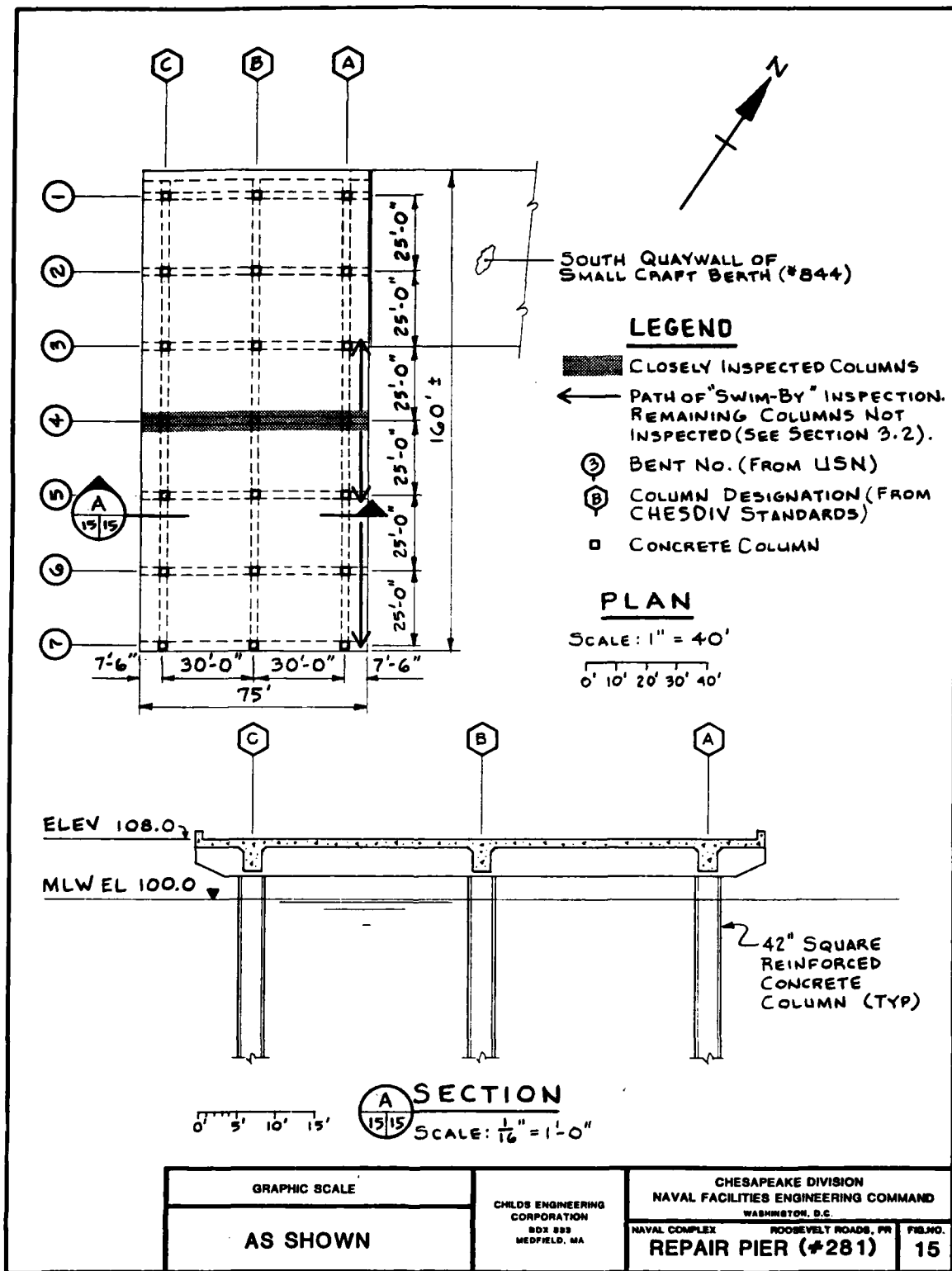
4.9 REPAIR PIER (281)

4.9.1. Description

The Repair Pier is located in the Puerca Bay area of the Naval Station. It adjoins the southwestern end of the South Quaywall of the Small Craft Berth (844), which borders one side of the mouth of Dry Dock No. 1. The use of the Repair Pier is presently restricted due to the deteriorated condition of the fender system, crane rails and land approach.

The 160' long x 75' wide Repair Pier was built around 1943. The reinforced concrete decking is supported by seven bents of 42" square reinforced concrete columns, apparently resting on concrete pedestals. There are a total of 21 vertical bearing columns (see Figure 15).

References: U.S. Naval Station - San Juan,
Bureau of Yards and Docks
"D.D. Quay Walls & Repair Pier"
Y & D Dwg. No. 928358



4.9.2 Observed Inspection Condition

No major structural deficiencies were observed in the reinforced concrete column foundation of the Repair Pier. Some softness was noted in the concrete columns around mean low water.

The reinforced concrete superstructure, including column caps, beams and decking, was severely deteriorated. There were large areas of severely spalled concrete in which reinforcing was exposed and rusting.

4.9.3 Structural Condition Assessment

The reinforced concrete column foundation of the Repair Pier is in good condition. It appears that the columns have the capacity to handle the applied loads.

4.9.4 Recommendations

Government-furnished information indicates that the Repair Pier is used only on a restricted basis. Therefore, no repairs are recommended for the column foundation at this time. If full use of this facility is desired, a thorough inspection of the reinforced concrete superstructure will be necessary to determine the extent of the deterioration and the repairs required for adequate rehabilitation.

4.10 SMALL CRAFT BERTH - NORTH & SOUTH QUAYWALLS (844)

4.10.1 Description

The Small Craft Berth is located on Puerca Bay in the Naval Station. It is comprised of two sections, the North and South Quaywalls, which flank the mouth of Dry Dock No. 1. The use of these quaywalls is currently restricted due to the deteriorated condition of the fender system (see Photo #21).

The Small Craft Berth was built around 1943. Each quaywall is 206' long x approximately 50' wide. The reinforced concrete deck of each quaywall is supported by eight bents of 42" square reinforced concrete columns, apparently resting on concrete pedestals. There are a total of 34 vertical bearing columns (see Figure 16).

References: U.S. Naval Station - San Juan,
Bureau of Yards and Docks
"D.D. Quay Walls & Repair Pier"
Y & D Dwg. No. 928358

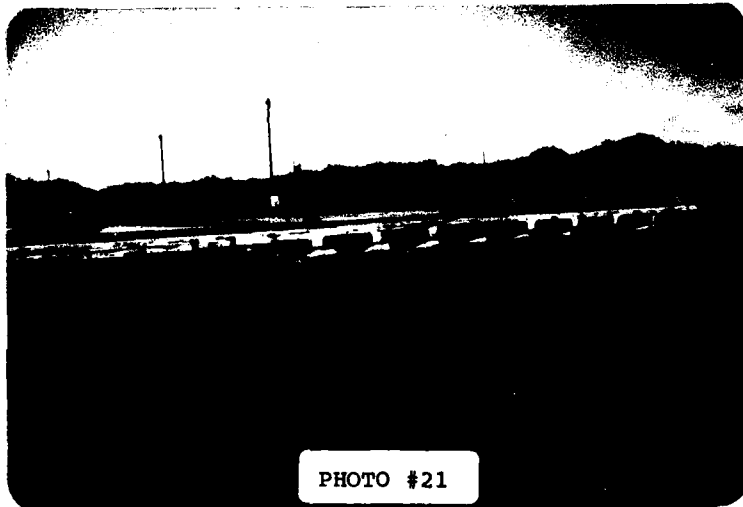
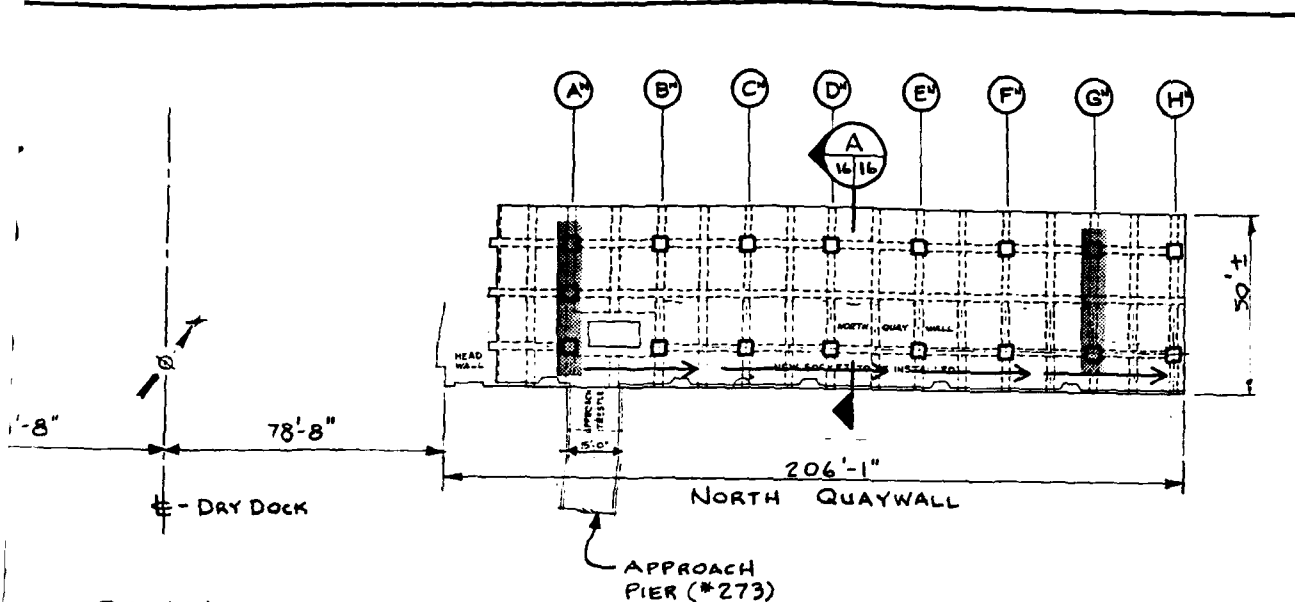


PHOTO #21: View of Face of North Quaywall
of Small Craft Berth (844).



LEGEND

- Ⓐ BENT NO. (FROM USN).
- Ⓑ COLUMN DESIGNATION (FROM CHESDIV STANDARDS).
- CLOSELY INSPECTED COLUMNS.
- ← PATH OF "SWIM-BY" INSPECTION REMAINING COLUMNS NOT INSPECTED (SEE SECTION 3.2).
- CONCRETE COLUMN

NOTE: PLAN AND SECTION TAKEN FROM Y&D DWG No. 928358.

GRAPHIC SCALE	CHILDS ENGINEERING CORPORATION BOX 889 MEDFIELD, MA	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.	NAVAL COMPLEX ROOSEVELT ROAD, PR	FILM NO. 16
AS SHOWN		SMALL CRAFT BERTH (#844)		

4.10.2 Observed Inspection Condition

No major structural deficiencies were observed in the reinforced concrete column foundation of the Small Craft Berth. Some softness was noted in the concrete columns around mean low water.

The reinforced concrete superstructure, including column caps, beams and decking, was severely deteriorated. There were large areas of severely spalled concrete in which reinforcing was exposed and rusting.

Soundings taken along the face of the facility indicated that water depths were approximately 30' at mean low water.

4.10.3 Structural Condition Assessment

The reinforced concrete column foundation of the Small Craft Berth is in good condition. It appears that the columns have the capacity to handle the applied loads.

4.10.4 Recommendations

Government-furnished information indicates that the Small Craft Berth is used only on a restricted basis. Therefore, no repairs are recommended for the column foundation at this time. If full use of this facility is desired, a thorough inspection of the reinforced concrete superstructure will be necessary to determine the extent of the deterioration and the repairs required for adequate rehabilitation.

4.11 AMMUNITION PIER - VIEQUES ISLAND (2018)

4.11.1 Description

The Ammunition Pier at Vieques Island, also called the Mosquito Pier, is located on the western edge of a breakwater and causeway built in the northwestern sector of the island. The pier is located near the outshore end of the breakwater and is used to transship ordnance to and from the ordnance storage area on Vieques Island.

The 651' long x 40' wide pier was built in 1966. The reinforced concrete deck is supported by 42 bents of 18" square precast, prestressed concrete piles (see Figure 17). There are a total of 94 batter and 172 vertical bearing piles. The deck is designed for a live load of 600 PSF uniform loading or a highway loading of AASHO H20-S16. The piles have a design bearing capacity of 60 tons. The pier is designed for a maximum lateral load of 2,000 PLF.

References: U.S. Naval Station - San Juan,
Bureau of Yards and Docks
"Weapons Handling Pier, Vieques Island"
Y & D Dwg. Nos. 1041814 and 1041815

AD-A167 550

UNDERWATER FACILITIES INSPECTIONS AND ASSESSMENTS AT US
NAVAL STATION 800 (U) CHIEFS ENGINEERING CORP MEDFIELD
MA FEB 82 CHES/NAUFAC-FFO-1-82 (11) N00000-82-0-0002

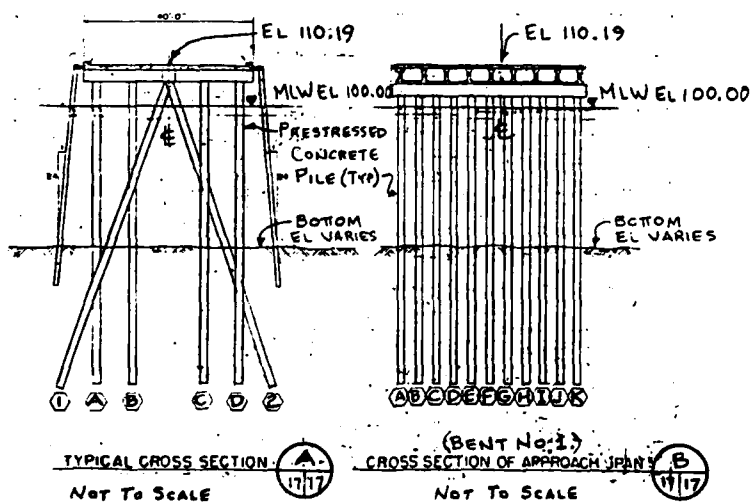
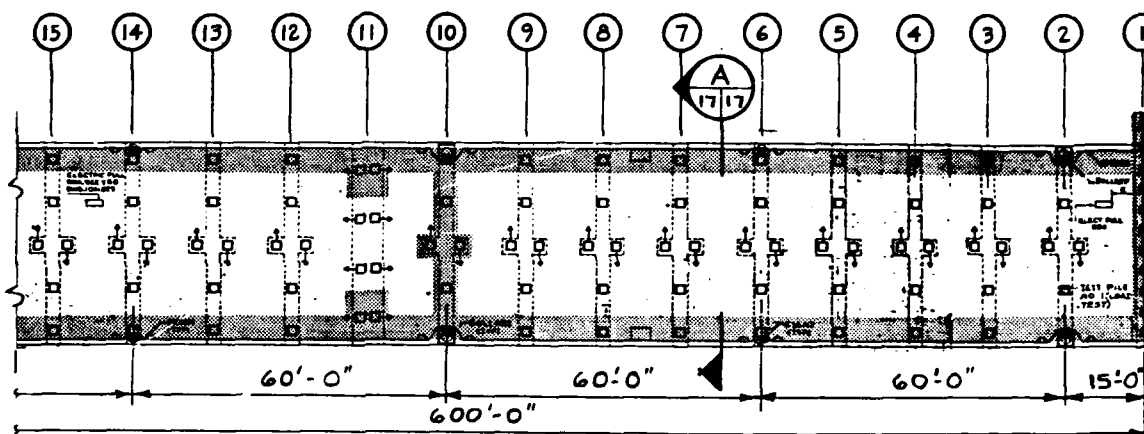
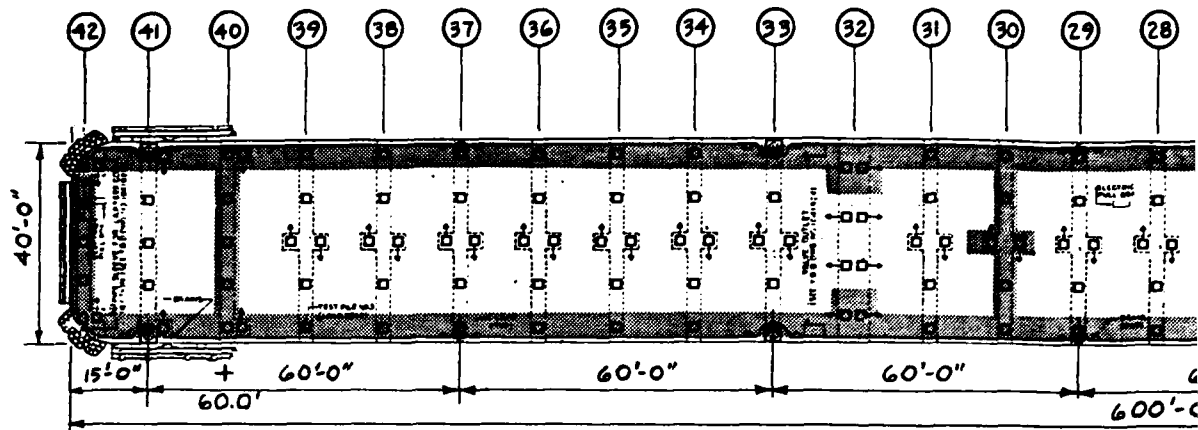
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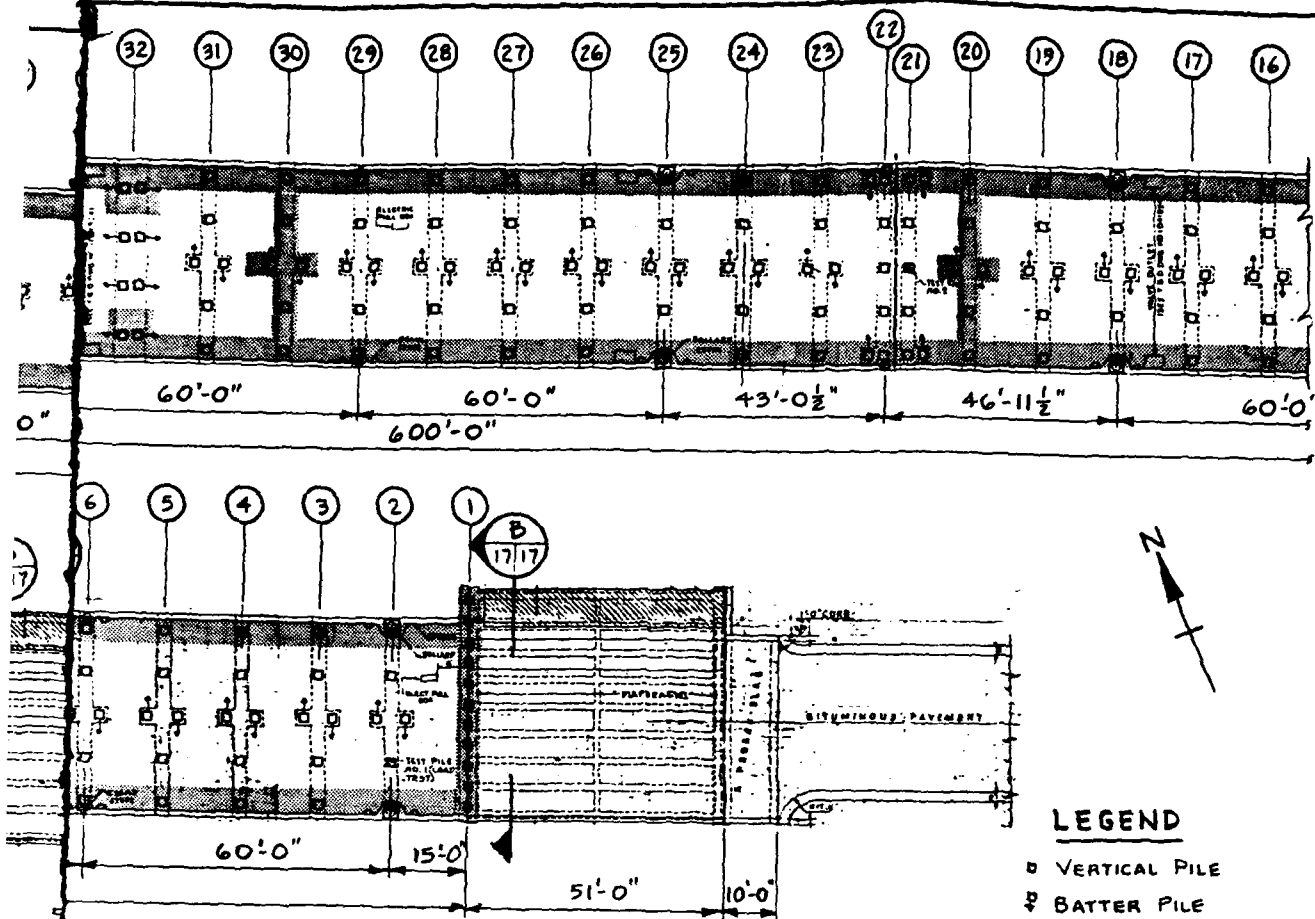
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GRAPHIC SCALE	CHILDS ENGINEERING CORPORATION BOX 388 MEDFORD, MA	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.	NAVAL COMPLEX ROOSEVELT ROAD, PR AMMO PIER - VIEQUES (#2018)	FILE NO. 17
AS SHOWN				

4.11.2 Observed Inspection Condition

No major structural deterioration was observed at the Ammunition Pier on Vieques Island. In general, all the piles were sound and exhibited little or no softness. Little or no spalling or cracking was observed. No significant cracking or spalling was noted in the pile caps or the superstructure.

Soundings taken along the perimeter of the pier indicated that the average water depth was approximately 40' at mean low water.

4.11.3 Structural Condition Assessment

The Ammunition Pier on Vieques Island is in excellent condition. No structural abnormalities or severe deterioration was observed which would reduce the capacity of the pile foundation. Any spalling or cracking noted is not structurally significant.

4.11.4 Recommendations

No repairs are required at this time. The Ammunition Pier should be reinspected in ten years to document any further deterioration. This report should be used as a baseline for future inspections.

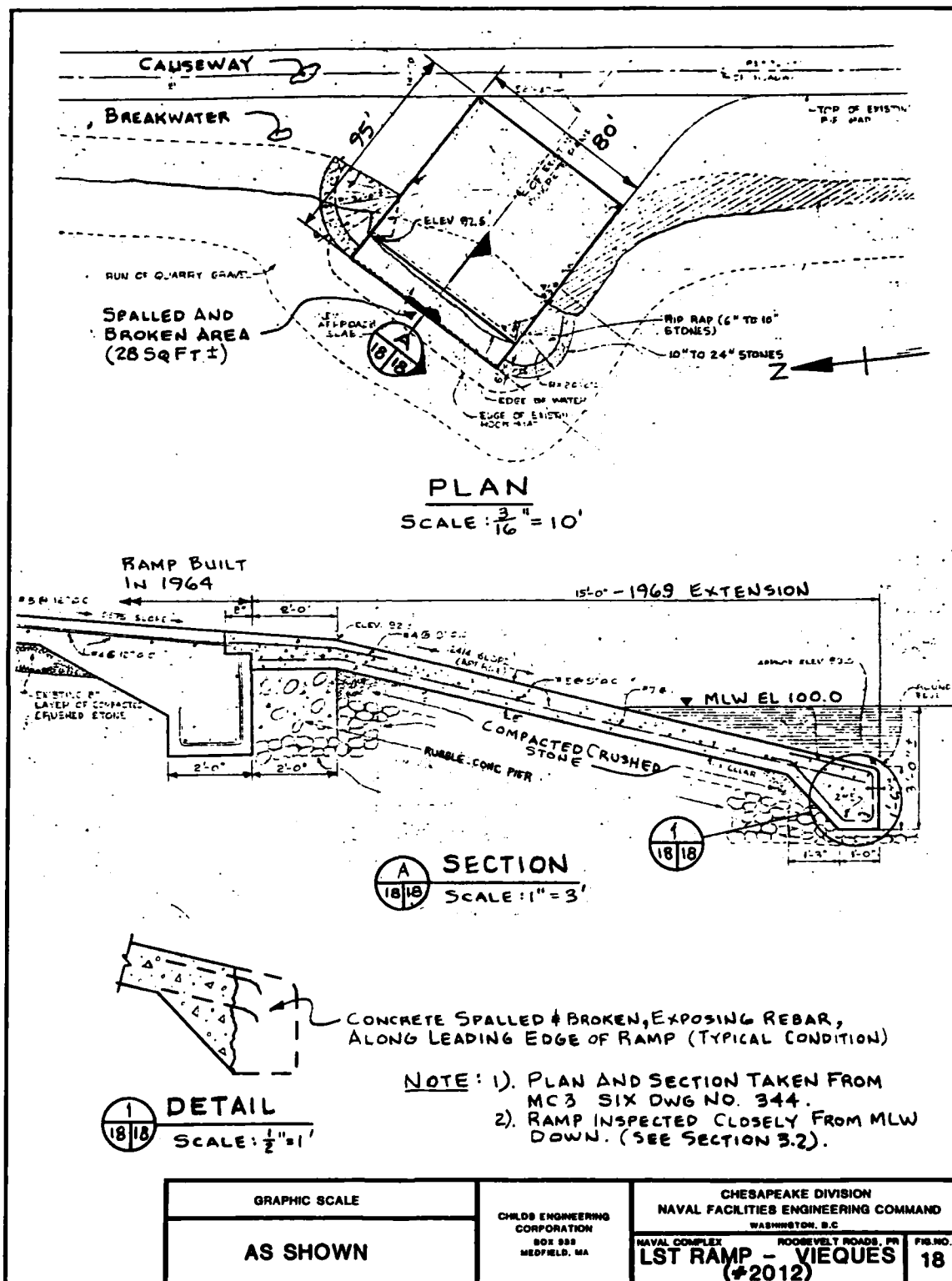
4.12 LST RAMP - VIEQUES ISLAND (2012)

4.12.1 Description

The LST Ramp on Vieques Island is located south of the Ammunition Pier (2018), midway along the western edge of the breakwater. It currently functions as a landing area for harbor utility craft (YFU) and tank landing ships (LST).

The LST Ramp was built in 1964. In 1969, a 15' extension was added to the outshore end, giving the ramp its present dimensions of 95' x 80'. The ramp is constructed of two cast-in-place reinforced slabs placed on a crushed stone base over a graded stone embankment (see Figure 18).

References: U.S. Naval Mobile Construction Battalion Six
"Vieques Island - LST Ramp Repairs"
MCB Six Dwg. No. 344



4.12.2 Observed Inspection Condition

Severe spalling of the concrete was noted along the submerged edge of the LST Ramp on Vieques Island (see Figure 18). Reinforcing was exposed in this area and in a deteriorated condition. In general, the remainder of the concrete ramp appeared sound.

4.12.3 Structural Condition Assessment

In general, the LST Ramp on Vieques Island is in good condition. The spalling and deterioration along the submerged edge of the ramp should be repaired to prevent further deterioration.

4.12.4 Recommendations

The submerged edge of the LST Ramp on Vieques Island should be repaired by patching with epoxy mortar. Prior to the placement of the new mortar, the existing concrete should be chipped to sound concrete and deteriorated reinforcing should be replaced. The new epoxy mortar should be placed or cast against the existing concrete. The estimated cost for these repairs is \$11,000.

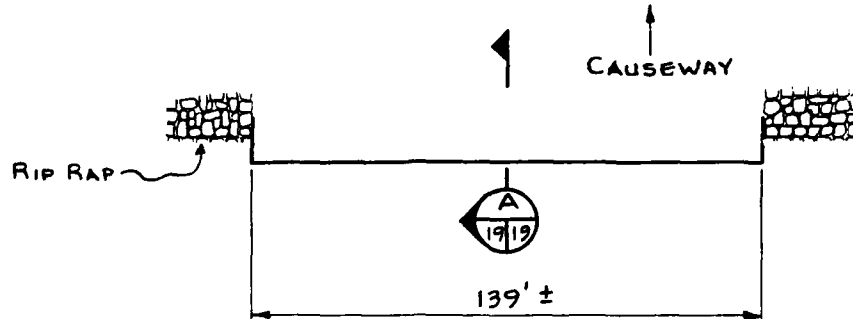
4.13 SMALL CRAFT BERTH - VIEQUES ISLAND

4.13.1 Description

The Small Craft Berth on Vieques Island is situated south of the LST Ramp (2012), on the western edge of the breakwater. Presently it functions as a small craft berthing area. However, based on its condition, it is probably restricted.

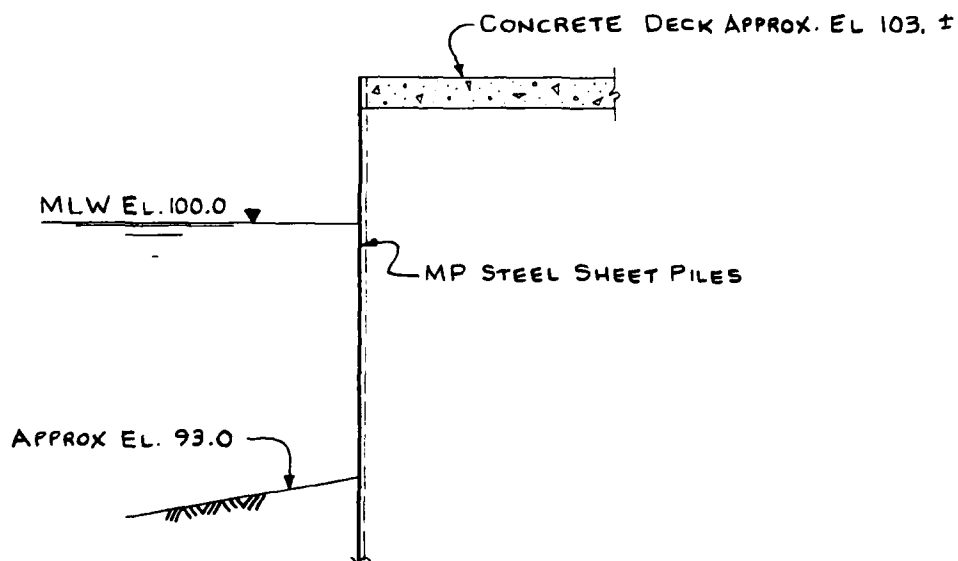
The Small Craft Berth is reported to have been built in 1940. The overall dimensions of the structure are approximately 139' x 26'. The basic structure is a cantilever steel sheet pile wall composed of MP sections, backfilled with granular fill and capped with a reinforced concrete deck (see Figure 19).

References: No government-furnished information detailing the construction of this facility was available. All such information provided herein is the result of the on-site inspection.



PLAN

SCALE: 1" = 40'



SECTION

SCALE: $\frac{1}{4}$ " = 1'-0"

NOTE: STEEL SHEET PILE WALL CLOSELY INSPECTED (SEE SECTION 3.2).

GRAPHIC SCALE	CHILDS ENGINEERING CORPORATION BOX 888 MEDFIELD, MA	CHESAPEAKE DIVISION NAVAL FACILITIES ENGINEERING COMMAND WASHINGTON, D.C.	
AS SHOWN		NAVAL COMPLEX SMALL CRAFT BERTH- VIEQUES	FIG. NO. 19

4.13.2 Observed Inspection Condition

The steel sheet pile wall was severely deteriorated around mean low water and in the splash zone. Holes were noted over 50% of the steel sheet piling in the splash zone area. In the area just below mean low water, the wall was severely corroded, and holes could easily be made in the steel with a chipping hammer. The steel sheet piling were also deflected outward, indicating that the imposed soil loads exceeded the wall's capacity.

The reinforced concrete deck has been patched several times. It appears that the deck has been enlarged on the outshore side in order to fill the voids created when the steel sheet piling deflected outward.

Soundings taken along the face of the wall indicated that the water depths ranged from 6'-8' at mean low water.

4.13.3 Structural Condition Assessment

The Small Craft Berth on Vieques Island is in poor condition. It has already experienced partial failure as evidenced by the severe outward displacement of the steel sheet pile wall. It appears that current use of the facility is minimal and perhaps restricted.

4.13.4 Recommendations

The facility should be used with caution due to its advanced state of deterioration. Government-furnished information indicates that a new design was developed for a Small Craft Berth at Vieques Island, implying that this facility has been in poor condition for some time. It is recommended that the present facility be abandoned and the proposed facility be constructed. Based on the details of the proposed design, the estimated cost for replacement of this facility is \$360,000.

TABLE OF CONTENTS FOR APPENDIX

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Repair Cost Estimates.....	A-2
Structural Analysis Calculations.....	A-8
Thickness Measurements.....	A-15

FOOTNOTES

1. MASTER PLAN, U.S. Naval Complex, Roosevelt Roads, Puerto Rico; Atlantic Division, Naval Facilities Engineering Command, p. III-1.
2. Ibid.
3. Ibid., p. II-9.
4. Ibid.
5. Ibid.
6. Ibid.
7. Ibid., p. II-10.
8. Ibid., p. II-19.
9. Ibid.
10. Ibid., pp. II-19 and II-20.
11. Ibid., p. II-10.
12. Ibid., p. II-14.

REPAIR COST ESTIMATE

SUPPLY PIER (267)

1) Repair spalled corner of pile:

- a) Chip to sound concrete, clean exposed steel, patch with epoxy mortar.

LumpSum Cost for One Pile = \$ 1,000

2) Repair and protect steel sheet pile bulkhead:

- a) Clean existing steel sheet piling and install reinforced concrete encasement from base of existing cap to elevation 97.0'.

13' deep x 1.5' wide x 70' long = 1365 c.f. = 51 c.y. x
\$1,000/c.y. = \$51,000

REPAIR COST ESTIMATE

BERTHING PIER (799)

- 1) Repair damaged pile by driving two (2) steel piles adjacent to the damaged pile through the concrete deck. Tie the piles into the pier with reinforced concrete and encase the piles in reinforced concrete jackets.

a) Demolition of deck:

Lump Sum	=	\$ 2,000
----------	---	----------

b) Install new HP 14x73's:

10,220lb @ \$.75/lb.	=	\$ 7,665
----------------------	---	----------

c) Cast new pile cap and jackets
(7c.y. of Concrete):

7c.y. x \$500/c.y.	=	\$ 3,500
--------------------	---	----------

d) Mobilization-Demobilization

Lump Sum	=	<u>\$ 2,000</u>
----------	---	-----------------

Total:	\$15,165
--------	----------

Budget:	\$16,000
---------	----------

REPAIR COST ESTIMATE

LST RAMP (843)

- 1) Repair deteriorated concrete area in tidal zone at center of ramp and along ramp face,

- a) Chip to sound concrete, clean and/or replace deteriorated reinforcing and cast new reinforced concrete section.

10'x 10'x 1.5' = 5.6c.y. concrete patch
@ \$600/c.y. = \$ 3,360

160s.f. epoxy mortar @ \$40/s.f. = \$ 6,400

- b) Pressure grout under ramp in damaged area to fill voids beneath concrete ramp.

10 holes @ 20 bags/hole = 200 bags
200 bags @ \$20/bag = \$ 4,000

Mobilization-Demobilization:
Lump Sum = \$ 2,000

Total: \$15,760

Budget: \$16,000

REPAIR COST ESTIMATE

APPROACH PIER (273)

1) Demolish pier:

- a) Remove all decking, piles, pile caps and steel sheet pile cylinders to the mudline.

Lump Sum = \$ 200,000

2) Repair pile caps and steel sheet pile cylinders:

- a) Clean to sound concrete; repair or replace reinforcing; patch pile caps with epoxy mortar.

84s.f./bent x 23 bents = 1932s.f. @ \$15/s.f.
= \$ 28,980

- b) Clean steel sheet pile cylinders from cap to elevation 97.0'. Encase existing cylinders with new coated steel sheet piles from cap to elevation 97.0'. Fill gap between cylinder and new sheet piles with reinforced concrete.

\$180,000/cylinder x 6 cylinders = \$1,080,000

- c) Patch split in steel sheet pile Cylinder B2 with steel plate.

Lump Sum = \$ 2,000

Total: \$1,110,980

Budget: \$1,200,000

REPAIR COST ESTIMATE

LST RAMP - VIEQUES ISLAND (2012)

- 1) Clean ramp face to sound concrete. Repair or replace deteriorated reinforcing. Patch with epoxy mortar.

268s.f. @ \$40/s.f.

= \$10,720

Budget: \$11,000

REPAIR COST ESTIMATE

SMALL CRAFT BERTH - VIEQUES ISLAND

- 1) Demolish existing berth and replace with new facility (existing design):

a) Demolition:

Lump Sum = \$ 20,000

- b) New Berth, including tied back steel sheet pile bulkhead, backfill and fender system:

197LF @ \$1,700/LF = \$334,900

Total: \$354,900

Budget: \$360,000

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SHEET NO 1 OF 3

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SCALE

FUEL PIER - PIER 1 (266) - COLUMN ANALYSIS

I. PILE LOAD ANALYSIS

[Refer to Childs Engineering Report entitled "Analysis of The Remaining Strength of Concrete Jacketed Steel H-Piles", Feb. 1982]

Assumption: Steel is A-7 ($F_y = 33$ KSI)

Definition of Terms:

K = Factor based on column end conditions (see Chart in report)

$K' = 1/\sqrt{K}$

l = length of column from pile cap to mudline plus 5' (in.)

l_e = effective length of column = $K'l$

E_t = Tangent Modulus (see Chart in report)

I_r = Average remaining Moment of Inertia of Column about its Y-Y axis (in⁴)

A_r = average remaining cross-sectional area of column (in²)

r_r = average remaining radius of gyration of column = $\sqrt{I_r/A_r}$ (in.)

P_{cr} = Overall Column Buckling Load (Factor of Safety not included) - (K)

σ_{cr} = Critical Column Buckling Stress (see Chart in report) - (KSI)

A/l = ratio of length of concrete jacket (A) to overall length of column (L) - (see Chart in report)

$\frac{E_2 I_2}{E_1 I_1}$ = Ratio relating the stiffness of the column encased in a concrete jacket ($E_2 I_2$) to the stiffness of the exposed column ($E_1 I_1$) - (see Chart in report)

Web_r = Average remaining web thickness (in.)

Fl_r = Average remaining flange thickness (in.)

Note: The columns investigated are in the inelastic buckling range ($l_e/r < C_c = 133.1$), so the tangent modulus, E_t , must be used to calculate P_{cr} and σ_{cr} :

$$\sigma_{cr} = \frac{K \pi^2 E_t}{(l_e/r)^2} = \frac{\pi^2 E_t}{(l_e/r)^2}$$

$$P_{cr} = \frac{K \pi^2 E_t I}{l^2} = (\sigma_{cr} A_r)$$

PILE	Type	Web _r	Fl _r	A _r	I _r	r _r	l	A/l	$\frac{E_2 I_2}{E_1 I_1}$	K	K'	$\frac{P_{cr}}{A_r}$	$\frac{P_{cr}}{A_r}$ (KSI)	$\frac{P_{cr}}{A_r}$ (K)
10-A	HP14x89	.531"	.531"	22.3	281.1	3.55	402"	.37	5.9	6.8	.383	.00525	31.7	707
24-A	HP14x102	.556"	.556"	23.5	299.6	3.57	414"	.36	5.7	6.7	.386	.00495	31.6	743

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SCALE

FUEL PIER - PIER 1 - continued

Jacket Stiffness $\left(\frac{E_2 I_2}{E_1 I_1}\right)$:

a) HP 14 x 89:

$$\frac{E_2}{E_1} I_2 = I_{\text{effective concrete}} + I_{\text{Y-Y-HP 14x89}} = \frac{(20'')^4}{12} (.1) + 326 = 1333 + 326 = 1659 \text{ in.}^4$$

$$\frac{E_2 I_2}{E_1 I_1} = \left(\frac{E_2}{E_1} I_2\right) \frac{1}{I_1} = \frac{1659}{281.1} = 5.9$$

b) HP 14 x 102:

$$\frac{E_2}{E_1} I_2 = I_{\text{effective concrete}} + I_{\text{Y-Y-HP 14x102}} = \frac{(20'')^4}{12} (.1) + 380 = 1333 + 380 = 1713 \text{ in.}^4$$

$$\frac{E_2 I_2}{E_1 I_1} = \left(\frac{E_2}{E_1} I_2\right) \left(\frac{1}{I_1}\right) = \frac{1713}{299.6} = 5.7$$

II. LOCAL BUCKLING

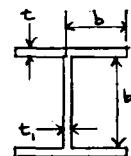
(note: Local Per has factor of safety incorporated)

Allowable Values:

$$t = \text{minimum flange thickness (in.)} \quad \frac{b}{t} \leq \frac{3050}{\sqrt{64}} = 16.5$$

where $\sigma_y = 33 \text{ ksi}$

$$t_1 = \text{minimum web thickness (in.)} \quad \frac{b_1}{t_1} \leq \frac{8080}{\sqrt{64}} = 44.0$$



Pile	b	t	b/t	b ₁	t ₁	b ₁ /t ₁	A _{min}	(ksi) Local σ _{cr}	(K) Local P _{cr}
10-A	7.35"	.500"	14.7	12.62"	No readings		—	—	—
24-A	7.39"	.219"	33.7*	12.62"	No readings		9.2 in ²	11.66	107

* Indicates ratio exceeds allowable value. (note: A_{min} = minimum remaining cross-sectional area of column in²)

Critical Local Buckling Stress for flanges: $\sigma_{cr} = \frac{.416 E}{1-\nu^2} \left(\frac{t}{b}\right)^2 = 13.282 \times 10^6 \left(\frac{t}{b}\right)^2$

where $\nu = .27$ and $E = 29.6 \times 10^6 \text{ psi}$

Critical Local Buckling Stress for webs: $\sigma_{cr} = \frac{3.29 E}{1-\nu^2} \left(\frac{t_1}{b_1}\right)^2 = 105.04 \times 10^6 \left(\frac{t_1}{b_1}\right)^2$

where $\nu = .27$ and $E = 29.6 \times 10^6 \text{ psi}$

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FUEL PIER - PIER 1 - continued

III. COMBINED BUCKLING LOADS

Pile	(K) Pier	Factor of Safety	(K) Column Pier	(K) Local Pier	Allowable Buckling Load
10-A	707 ^K	2.75	257 ^K	—	257 K = 128 Tons
24-A	743 ^K	2.75	270 ^K	107 ^K	107 K = 53.5 Tons

∴ Local buckling is controlling for Pile 24-A.

IV. PIER LOADING

Dead Load:

$$\text{Deck Volume} \Rightarrow (10.25' \text{W} \times 14.0' \text{L} \times 0.7' \text{D}) +$$

$$\text{Concrete Beam Volume} \Rightarrow (1.5' \text{W} \times 11.8' \text{L} \times 2.7' \text{D}) \times 2 +$$

$$\text{Concrete Jacket Volume} \Rightarrow (1.7' \text{W} \times 1.7' \text{D} \times 12.5' \text{L}) +$$

$$\text{Pile Cap Volume} \Rightarrow (2.2' \text{W} \times 4.5' \text{D} \times 10.25' \text{L}) =$$

$$\text{TOTAL Volume} \Rightarrow 332.5 \text{ c.f. of concrete}$$

$$\text{Wt. of Concrete} \Rightarrow 150 \text{ pcf} \times 332.5 \text{ cf} = 49,875 \text{ lbs.}$$

$$\text{Wt. of Steel Beams} \Rightarrow 58 \text{ lbs/ft} \times 14' \text{ beam} \times 2 \text{ Beams} = 1,624 \text{ lbs.}$$

$$\text{Total Wt. of Superstructure} = 49,875 \text{ lbs} + 1,624 \text{ lbs} = 51,499 \text{ lbs.}$$

$$\text{DEAD LOAD} = 51,499 \text{ lbs} / 143.5 \text{ sq. ft.} = 358.9 \text{ psf} \approx 360 \text{ psf.}$$

$$\text{Design Live Load of Deck} = 200 \text{ psf, uniform loading}$$

$$\text{TOTAL LOAD} = \text{LIVE LOAD} + \text{DEAD LOAD} = 360 \text{ psf} + 200 \text{ psf} = 560 \text{ psf.}$$

CONCLUSION:

∴ Piles must have a minimum bearing capacity of $560 \text{ psf} \times 143.5 \text{ sf} =$

$$80,360 \text{ lbs} = 40.2 \text{ Tons.}$$

As seen in Part III, both piles analyzed can carry the imposed loads.

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SCALE

BERTHING PIER - PIER 3 (799) - Column ANALYSIS

[Refer to Childs Engineering Report entitled "Analysis of The Remaining Strength of Concrete Jacketed Steel H-Piles", Feb. 1982]

I. PILE LOAD ANALYSIS

[Refer to Fuel Pier Column Analysis for Definition of Terms used below]

Assumption: Steel is A-7 ($F_y = 33$ KSI)

Note: The columns investigated are in the inelastic buckling range ($l_e/r < C_c = 133.1$), so the tangent modulus, E_t must be used to calculate column P_{cr} & G_{cr} .

$$G_{cr} = \frac{K \pi^2 E_t}{(l/r)^2} = \frac{\pi^2 E_t}{(l_e/r)^2} \quad P_{cr} = (G_{cr})(A_r)$$

Pile	Type	Web	F_r	A_r	I_r	r_r	l	A/r	$\frac{E_2 I_2}{E_1 I_1}$	K	K'	$\frac{\pi^2}{(l_e/r)^2}$	G_{cr} (KSI)	P_{cr} (K)
5-T 10-T (Composite of the two)	HP 14x73	.478"	.503"	20.7	260.2	3.55	336"	.28	9.6	7.0	.378	.00771	32.2	666

Jacket Stiffness ($\frac{E_2 I_2}{E_1 I_1}$):

$$\frac{E_2}{E_1} I_2 = I_{\text{effective concrete}} + I_{Y-Y-HP14x73} = \frac{\pi (26")^4}{64} (.1) + 262 = 2243 + 262 = 2505 \text{ in.}^4$$

$$\frac{E_2 I_2}{E_1 I_1} = \left(\frac{E_2}{E_1} I_2 \right) \frac{1}{I_1} = \frac{2505}{260.2} = 9.6$$

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JOB 497-82 - USN, Roosevelt Roads, P.R.
SHEET NO 2 OF 2
CALCULATED BY BWL DATE 3-12-82
CHECKED BY DLP DATE 4/22/82
SCALE _____

Berthing Pier - Pier 3 - continued

II. LOCAL BUCKLING

[Refer to Fuel Pier Column Analysis for Definition of Terms used below]

Pile	b	t	b/t	b ₁	t ₁	b ₁ /t ₁
S-T & 10T	7.29"	.485"	15.0	12.63"	.435"	29.0

The above ratios (b/t and b₁/t₁) have not exceeded allowable values. Therefore, local buckling is not controlling.

III. COMBINED BUCKLING LOADS

Since local buckling is not controlling, The allowable buckling load for the analyzed composite pile is

$$\frac{P_{cr}}{\text{Factor of Safety}} = \frac{666 \text{ K}}{2.75} = 242 \text{ K} = 121 \text{ Tons}$$

IV. PIER LOADING

$$\text{Deck Volume} \Rightarrow (6.0' \text{ w} \times 20.0' \text{ L} \times 1.0' \text{ D}) +$$

$$\text{Pile Cap Volume} \Rightarrow (4.5' \text{ D} \times 3.5' \text{ w} \times 6.0' \text{ L}) +$$

$$\text{Beam Volume} \Rightarrow (1.5' \text{ D} \times 6.0' \text{ w} \times 16.5' \text{ L}) + (1.5' \text{ D} \times 1.5' \text{ w} \times 16.5' \text{ L}) +$$

$$\text{Concrete Jacket Volume} \Rightarrow (8.0' \text{ L} \times (1.1')^2 \pi) =$$

$$\text{TOTAL VOLUME} \Rightarrow 430.5 \text{ cf.}$$

$$\text{Weight of Concrete} \Rightarrow 150 \text{ pcf} \times 430.5 \text{ cf.} = 64,575 \text{ lbs.}$$

$$\text{DEAD LOAD} \Rightarrow 64,575 \text{ lbs.} / 120.0 \text{ sq ft.} = 538 \text{ psf}$$

Design Live Load of Deck is 500 psf uniform loading.

$$\text{TOTAL LOAD} = \text{DEAD LOAD} + \text{LIVE LOAD} = 538 \text{ psf} + 500 \text{ psf} = 1038 \text{ psf}$$

CONCLUSIONS:

Piles must have a minimum bearing capacity of
 $1038 \text{ psf} \times 120.0 \text{ sf} = 124,560 \text{ lbs.} = 62.3 \text{ Tons.}$

As seen in Part III, The composite pile analyzed is adequate to carry the imposed loads.

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SHEET NO 1 OF 2
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CHECKED BY DLP DATE 4/22/82
SCALE _____

AMMUNITION PIER (277) at NAVAL STATION - COLUMN ANALYSIS
[Refer to Childs Engineering Report Entitled "Analysis of the Remaining Strength of Concrete Jacketed Steel H-Piles", Feb. 1982]

I. PILE LOAD ANALYSIS

[Refer to Fuel Pier Column Analysis for Definition of Terms used below]

Assumption: Steel is A-7 ($F_y = 33 \text{ KSI}$).

Note: These columns are 12" ϕ Steel Pipe Piles, so there is only an average and a minimum thickness (no flange vs. web thicknesses). Also, local buckling is not a factor in this analysis. There are no jackets either. The columns investigated are in the inelastic buckling range ($l_e/r \leq C_c = 133.1$), so the tangent modulus, E_t , must be used to calculate column P_{cr} & ϕ_{cr} .

$$\phi_{cr} = \frac{\pi^2 E_t}{(l_e/r)^2} \quad P_{cr} = (\phi_{cr})(A_r)$$

Pile	Original ϕ		Avg. Remaining Thickness	(in^2)		(in^4)		(in)	l	K	K'	$\pi^2 E_t / (l_e/r)^2$	(KSI) ϕ_{cr}	(K) P_{cr}
	Inside	Outside		A_r	I_r	r								
6-F	12.000"	12.750"	.336"	13.0	247.9	4.37	240"	4.0	0.500	.01309		32.5	422	
15-A	11.750"	12.750"	.399"	15.2	281.3	4.30	324"	4.0	0.500	.00695		32.0	486	

II. ALLOWABLE BUCKLING LOADS

Since local buckling is not a factor with these piles, the allowable buckling loads are as follows:

Pile	(K) P_{cr}	Factor of Safety	Allowable Buckling Load (Column P_{cr})
6-F	422	2.75	153 K = 76.5 Tons
15-A	486	2.75	177 K = 88.5 Tons

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CALCULATED BY BWL DATE 3-3-82
CHECKED BY DLP DATE 4/22/82
SCALE

AMMUNITION PIER (277) - continued

III. PIER LOADING

Dead Load:

$$\begin{aligned}\text{Deck Volume} &\Rightarrow (10.0' L \times 3.9' W \times 1.0' D) + \\ \text{Pile Cap Volume} &\Rightarrow (4.5' W \times 3.9' L \times 4.3' D) + (4.5' W \times 3.9' L \times 3.0' D) + \\ \text{Beam Volume} &\Rightarrow (1.5' W \times 5.5' L \times 1.5' D) + \\ \text{Curb Volume} &\Rightarrow (1.0' W \times 10.0' L \times 1.1' D) = \\ \text{TOTAL VOLUME} &\Rightarrow 190.5 \text{ cf.}\end{aligned}$$

$$\text{Total Weight of Superstructure} = 150 \text{ pcf} \times 190.5 \text{ cf.} = 28,575 \text{ lbs.}$$

$$\text{DEAD LOAD} = 28,575 \text{ lbs} / 39.0 \text{ sf} = 733 \text{ psf}$$

Assuming a Deck Design Live Load of 600 psf uniform loading,

$$\begin{aligned}\text{TOTAL LOAD} &= \text{DEAD LOAD} + \text{LIVE LOAD} = 733 \text{ psf} + 600 \text{ psf} \\ &= 1333 \text{ psf.}\end{aligned}$$

CONCLUSIONS:

∴ Piles must have a minimum bearing capacity of

$$1333 \text{ psf} \times 39.0 \text{ sf} = 51,987 \text{ lbs} = 26.0 \text{ Tons}$$

AS seen in Part II, both piles analyzed can carry the imposed loads.

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497-82 USN, ROOSEVELT RDS., PR

JOB

SHEET NO. 1 OF 1

CALCULATED BY DATE

CHECKED BY DATE

SCALE

JACKETED H-PILE

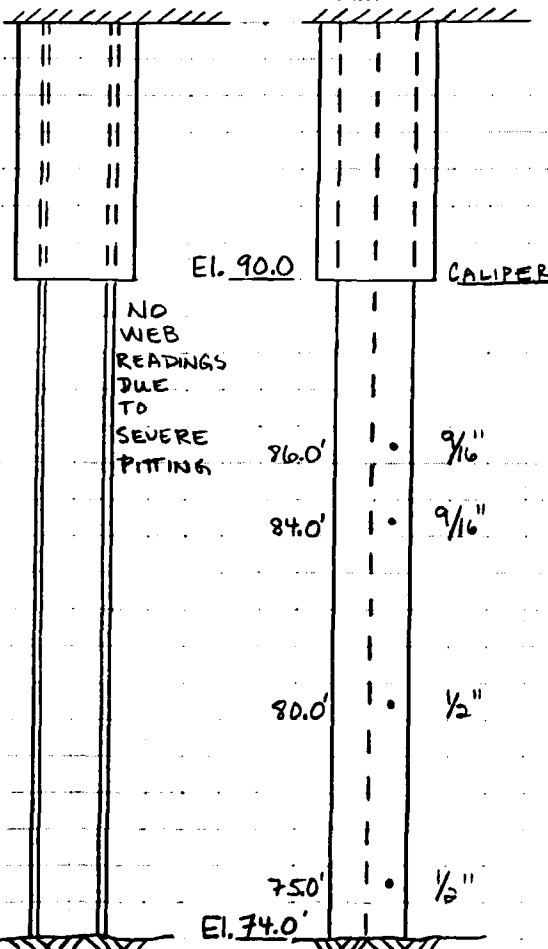
STEEL THICKNESS MEASUREMENTS

LOCATION NAVAL STATION

PIER #1 - FUEL PIER
(266)

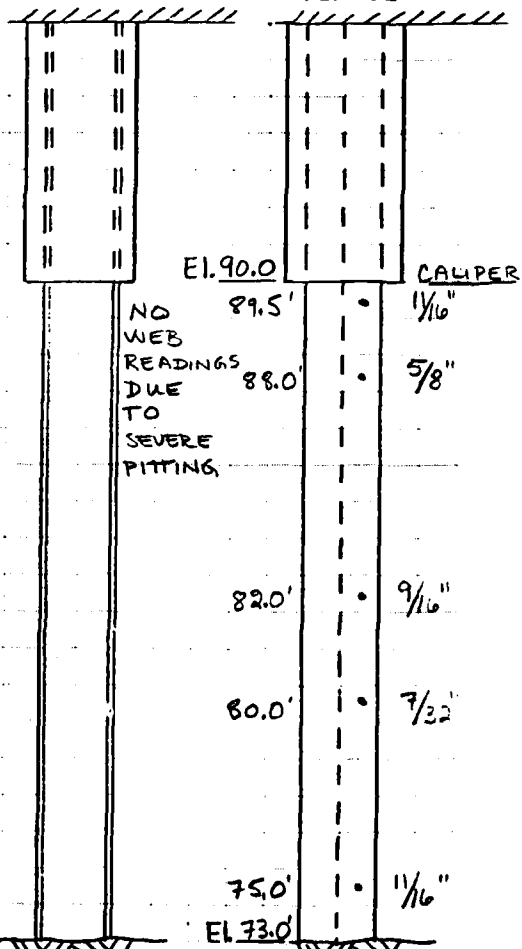
BENT 10 PILE A
PILE TYPE HP 14 x 89 (estimated)

ORIGINAL THICKNESS: ORIGINAL THICKNESS: .616"
WEB FLANGE



BENT 24 PILE A
PILE TYPE HP 14 x 102 (esti.)

ORIGINAL THICKNESS: ORIGINAL THICKNESS: .704"
WEB FLANGE



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CHILDS ENGINEERING CORPORATION
Box 333
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SHEET PILE BULKHEAD

JOB 497-82 USN, ROOSEVELT RDS., PR

SHEET NO. 1 OF 1

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

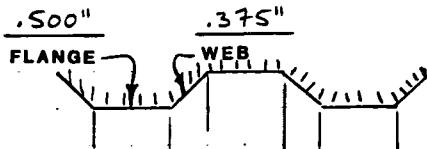
SCALE _____

STEEL THICKNESS MEASUREMENT

LOCATION NAVAL STATION STATION SOUTH WING WALL
SUPPLY PIER - PIER 2 (267)

PILE TYPE PZ 32

ORIGINAL THICKNESS:



ELEV.

99.0' .440" • • .375"

97.0' .470" • • .340"

~~MEASURED~~

EL. N/A

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CHILDS ENGINEERING CORPORATION
Box 333
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497-82 USN, ROOSEVELT RDS., PR

JOB _____
SHEET NO. _____ OF _____
CALCULATED BY _____ DATE _____
CHECKED BY _____ DATE _____
SCALE _____

JACKETED H-PILE

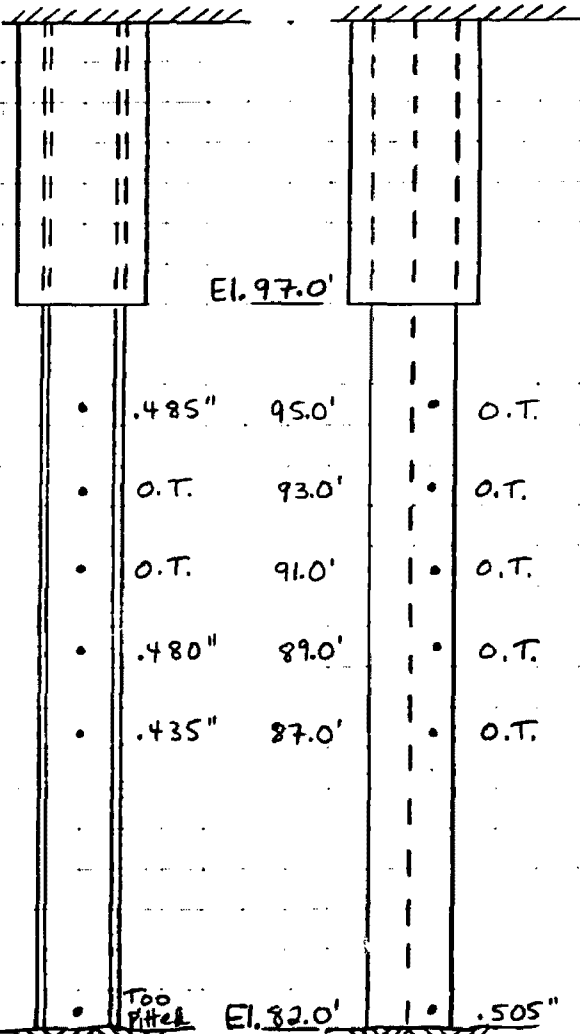
STEEL THICKNESS MEASUREMENTS

LOCATION NAVAL STATION

PIER #3 - BERTHING PIER
(799)

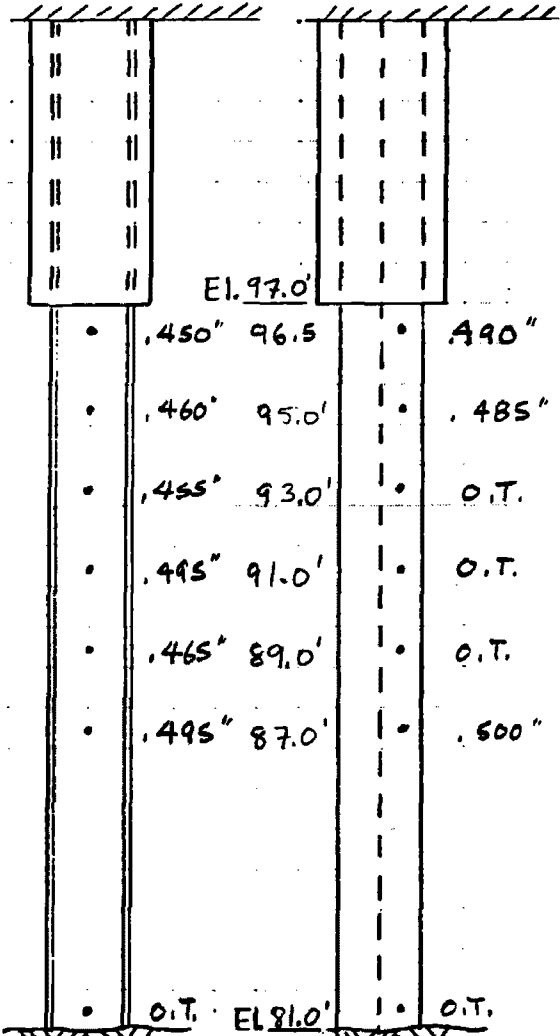
BENT 5 PILE T
PILE TYPE HP 14x73

ORIGINAL THICKNESS: .506" WEB
ORIGINAL THICKNESS: .506" FLANGE



BENT 10 PILE T
PILE TYPE HP 14x73

ORIGINAL THICKNESS: .506" WEB
ORIGINAL THICKNESS: .506" FLANGE



NOTE: O.T. = ORIGINAL THICKNESS

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CHILDS ENGINEERING CORPORATION
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JOB 497-82 USN, ROOSEVELT RDS., PR
SHEET NO. 1 OF 1
CALCULATED BY DATE
CHECKED BY DATE
SCALE

PIPE PILE

STEEL THICKNESS MEASUREMENTS

LOCATION NAVAL STATION

PIER AMMUNITION PIER (377)

BENT 6 PILE F
PILE TYPE 12" ϕ Steel Pipe Pile

ORIGINAL THICKNESS: $\frac{3}{8}$ " (estimated)

East side

South side

		ELEV.		
•	.340"	99.0'	•	.305"
•	.365"	97.0'	•	.345"
•	.305"	95.0'	•	-
•	-	93.0'	•	.325"
•	.370"	91.0'	•	.335"
•	.280"	89.0'	•	.315"
•	.370"	El. 84.0'	•	.375"

BENT 15 PILE A
PILE TYPE 12" ϕ Steel Pipe Pile

ORIGINAL THICKNESS: $\frac{1}{2}$ " (estimated)

East side

North side

		ELEV.		
•	-	99.0'	•	.390"
•	.420"	97.0'	•	.480"
•	.450"	95.0'	•	.435"
•	.385"	93.0'	•	.410"
•	.400"	91.0'	•	.385"
•	.385"	89.0'	•	.430"
•	.390"	84.0'	•	.315"
•	.365"	79.0'	•	.340"
•	.370"	El. 77.0'	•	

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SHEET PILE BULKHEAD

JOB 497-82 USN, ROOSEVELT RDS., PR

SHEET NO. 1 of 4

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

STEEL THICKNESS MEASUREMENT

LOCATION NAVAL STATION, BERTHING STATION USN Sta. S+50
WHARF (890) - SECTION A

PILE TYPE E 32 (Approximate)

ORIGINAL THICKNESS: $\frac{1}{2}$ " (.500") $\frac{3}{8}$ " (.375")

FLANGE

WEB

BASE OF CAP EL. 98.0'

97.5' .425" • • O.T.

96.0' .435" • • O.T.

94.0' .445" • • .365'

92.0' .450" • • O.T.

90.0' .410" • • O.T.

86.0' .445" • • O.T.

EL. 86.0'

Note: O.T. = Original Thickness A-19

CHILDS ENGINEERING CORPORATION
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SHEET PILE BULKHEAD

JOB 497-82 USN, ROOSEVELT RDS., PR

SHEET NO. 2 of 4

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

STEEL THICKNESS MEASUREMENT

LOCATION NAVAL STATION, BERTHING STATION USN Sta. 4+45
WHARF (890) - SECTION B

PILE TYPE Z32 (Approximate)

ORIGINAL THICKNESS: 1/2" (.500") 3/8" (.375")

FLANGE

WEB

BASE OF CAP EL. 99.0'

97.5' .430" • • O.T.

96.0' .400" • • .365"

94.0' .415" • • O.T.

92.0' .410" • • .355"

90.0' .410" • • O.T.

88.0' .415" • • O.T.

85.0'

EL. 85.0'

NOTE:

O.T. = Original Thickness

A-20

CHILDS ENGINEERING CORPORATION
Box 333
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SHEET PILE BULKHEAD

JOB 497-82 USN, ROOSEVELT RDS., PR

SHEET NO. 3 OF 4

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

STEEL THICKNESS MEASUREMENT

LOCATION NAVAL STATION, BERTHING WHARF (990) - SECTION C STATION CEC Sta. 7+00

PILE TYPE E 38 (Approximate)

ORIGINAL THICKNESS: 1/2" (.500") 3/8" (.375")

FLANGE

WEB

BASE OF CAP EL. <u>98.0'</u>					
97.5'	O.T.	•	•	.355"	
97.0'	.490"	•	•	.360"	
95.0'	.475"	•	•	.365"	
93.0'	.475"	•	•	O.T.	
91.0'	.485"	•	•	.355"	
89.0'	.480"	•	•	.370"	
87.0'	.495"	•	•	O.T.	
82.0'	.495"	•	•	O.T.	EL. <u>82.0'</u>

NOTE:

O.T. = Original Thickness

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CHILDS ENGINEERING CORPORATION
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SHEET PILE BULKHEAD

JOB 497-82 USN, ROOSEVELT RDS., PR

SHEET NO. 4 of 4

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

STEEL THICKNESS MEASUREMENT

LOCATION NAVAL STATION, BERTHING WHARF (890) - SECTION D STATION CEC Sta. 2+75

PILE TYPE 232 (Approximate)

ORIGINAL THICKNESS: $\frac{1}{2}$ " (.500") $\frac{3}{8}$ " (.375")

FLANGE

WEB

BASE OF CAP EL. 98.0'

97.5' .430" • • O.T.

96.0' .425" • • .370"

94.0' .425" • • .365"

92.0' .410" • • O.T.

90.0' .415" • • O.T.

88.0' .415" • • O.T.

83.0' • • O.T.

EL. 83.0'

Note

O.T. = Original Thickness

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CHILDS ENGINEERING CORPORATION
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SHEET PILE BULKHEAD

JOB 497-82 USN, ROOSEVELT RDS., PR

SHEET NO. 1 OF 1

CALCULATED BY DATE

CHECKED BY DATE

SCALE

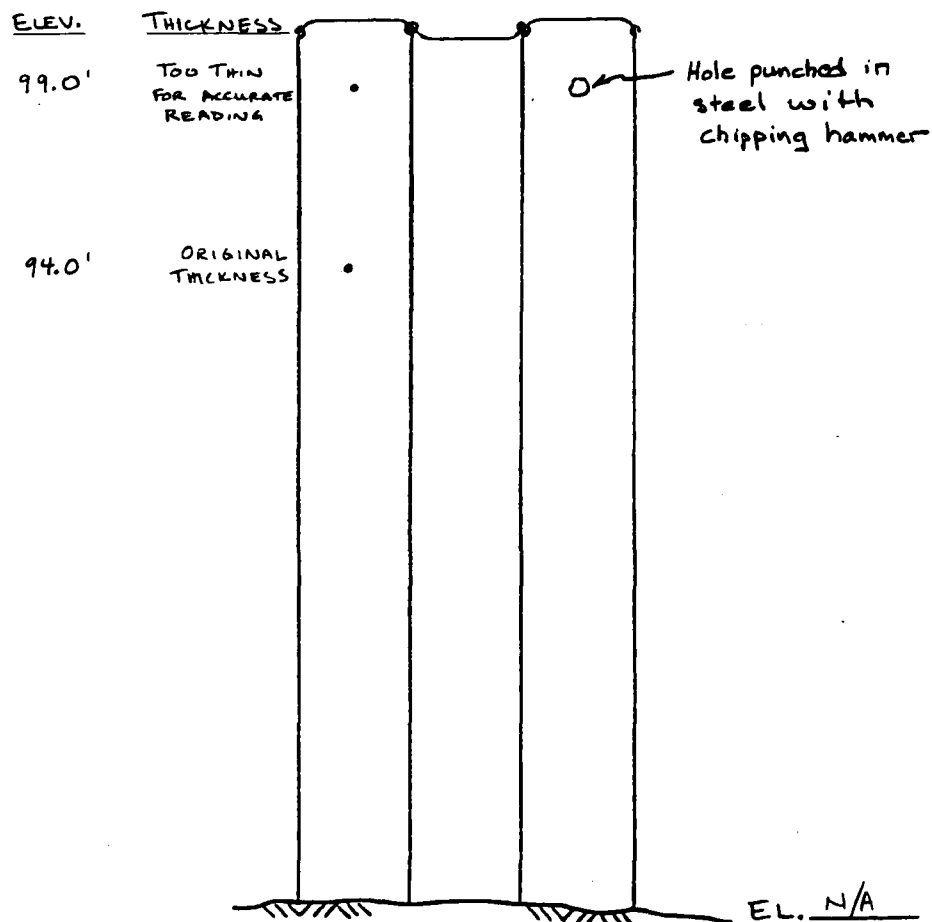
STEEL THICKNESS MEASUREMENT

LOCATION NAVAL STATION
APPROACH PIER (273)

STATION CELL B1, NORTH SIDE

PILE TYPE M-112

ORIGINAL THICKNESS: .375"



A-23

END

DATE
FILMED

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